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ELECTRICAL MOTIVE POWER.

IN spite of the comparatively slow progress which the application of electricity to the transmission of motive power is making, yet we believe that in the not distant future this application will make very considerable strides. So long as trade remains stagnant, any decided steps are unlikely, but depression is only a matter of time, and this period of inactivity may be taken advantage of by bringing as nearly as possible to perfection, inventions which can hardly fail to be appreciated in times of prosperity. Considering the attention which has been paid to the subject of accumulators, the practical results hitherto arrived at cannot be considered altogether satisfactory, a really good accumulator having yet to be discovered, or at least to be put on the market. The value of this form of battery is, for certain purposes, becoming more apparent every day, and its employment in the place of existing forms of primary batteries would, we think, prove both convenient and economical. For railway telegraphic purposes there seems little reason why accumulators should not be employed, the cells being charged at a stores depot, and then sent out to replace those which are approaching exhaustion at the various signal cabins and telegraph offices. If the adoption of electrically-worked distant signals should become general, the employment of accumulators for actuating them might become extensive. For certain classes of electric railways and tramways the use of accumulators carried by the cars is, we believe, the most satisfactory method for producing the motive force. The disadvantages of the conducting rail system are numerous; we have loss of current from defective insulation, reduced current from the rubbing brushes making bad or indifferent contact against the conductor, the possibility of a short circuit being made at any point along the line, and danger to individuals touching the conductor, especially in wet weather. Again, unless very massive conductors are used, or dangerously high tension currents are employed, the power available to drive the cars becomes less and less, according as the latter recede from the generating station. The difficulty of working any considerable number of cars on the same line at the same speed under the parallel system has, we believe, been found somewhat inconvenient; in fact, up to the present no remedy has been found for it, except the use of a series system with the objectionable high tension currents. It is, of course, quite possible to exaggerate the facts we have stated; but, at the same time, it cannot be denied that the accumulator system of propulsion is free from the objections stated, whilst it possesses many extra advantages. The system can be adapted to any existing tramway without the necessity of altering the permanent way in any respect. The power being self-contained, it is available at any spot required, so that shunting operations over the most complicated system of rails can always be carried on without difficulty, a point of considerable importance. The fact that any number of cars can be run quite independent of each other is a point also which should not be overlooked.

As regards the cost of the two systems it must be pointed out that the longer the length of the tramway to be worked the greater will be the cost involved in laying down a conducting rail; but this increase of cost will be in a much greater proportion than the increase in length, since the dimensions of the conductor would have also to be increased so as to avoid an increase in resistance and consequent waste of power. If a portion of the road becomes flooded in extremely wet weather an interruption might arise with the conductor system; but if accumulators are used such a result cannot occur. The practicability of working tramcars by secondary cells is, we think, proved, and the points of detail in connection with the same have been worked out. There is very little, if any more, difficulty in changing the cells at the end of a journey than in changing horses, and it is stated, and, we believe, on reasonable grounds, that the cost compared with horse-power is very favourable; where water-power is available for charging the accumulators, the economical advantage is therefore obvious.

EXPERIMENTAL RESEARCHES IN MAGNETISM.*

By PROF. J. A. EWING, B.Sc., F.R.S.E., University College, Dundee.

IN these experiments the author showed that by vibrating a piece of soft iron during the application and removal of magnetising force, the iron is then found to possess almost no retentiveness. But when the application and removal of magnetising force are effected without mechanical disturbance, the retentiveness of soft iron is found to be even greater than that of steel. In some cases 93 per cent. of the whole induced magnetism of a piece of annealed iron was found to remain on the complete removal of the magnetising force. It is pointed out that there is no discrepancy between this result and the well-known fact that a *short* iron core of an electro-magnet retains almost no magnetism when the current in the magnet is interrupted. In that case the ends of the magnet itself, after the interruption of the current, exert a sufficient reversed magnetising force to destroy almost entirely the residual magnetism. But when tested under the conditions which give uniform magnetisation and avoid the demagnetising influence of the ends, soft annealed iron is more retentive than even the hardest steel. Examples are given showing that the influence of permanent set in the curve of magnetisation is so marked as to give a criterion by which a strained piece may be readily distinguished from an annealed piece of metal, and that strain diminishes very greatly the magnetic retentiveness of iron. Numerical values of the coefficients of permeability and of susceptibility are given for a number of samples of iron and steel. The effects of stress (consisting of longitudinal pull)

* Abstract of paper read before the Royal Society, January 8th, 1885.

on the magnetic susceptibility and retentiveness of iron are also dealt with, and the subject is taken up in two different ways. In one the magnetic effects are observed when a load hanging from the wire under examination is gradually applied, removed, and otherwise varied, the wire being then either kept in a magnetising field of constant value or freed from all magnetising force. In the other method the load is kept constant, and magnetising force is applied, removed, and otherwise varied. The two methods give results which would be identical were it not for (1) hysteresis (static lagging action of magnetism) in the relation of magnetism to load in a constant field, and (2) hysteresis in the relation of magnetism to field under constant load. The relation of magnetism to varying load in a constant field is examined at great length, both in soft annealed wire and in wire hardened by stretching, and the effects, which are very complex, are exhibited graphically. They also afford an easy criterion by which a stretched piece can be distinguished from an annealed piece, and, both in stretched and annealed metal, they exhibit static hysteresis, which can be more or less completely wiped out by mechanical vibration. The connection of the author's present work with the earlier results of Villari, and the extensive researches of Sir W. Thomson, is pointed out. Numerous curves are given, which show very clearly the position of what Thomson has called the "Villari critical point," or point at which the sign of the effect of stress on magnetism becomes reversed; and it is shown that this reversal is associated rather with a particular value of magnetisation than with a particular value of magnetising force, the same reversal being found to occur when the magnetism dealt with is wholly residual. Instances are given of very curious molecular reminiscences of previous loads, which were found to exist even when the previous loading had been performed at a time when the metal was entirely destitute of magnetism, and although the loads whose effects were found to remain were much less than loads previously applied to the same wire, and were consequently unable to produce mechanical change of any ordinary kind. These residual effects of former loads became visible on the next magnetisation of the piece. It is shown that these effects of previous loads can be almost obliterated by subjecting the wire to vibration before beginning to magnetise it. The ratio of residual to induced magnetism in soft and hardened iron and steel has been examined for various degrees of magnetisation, with the result of showing that the ratio passes a maximum when the magnetisation is moderately strong, and then falls off as the state of so-called saturation is reached. The influence of the presence of stress on this ratio and on residual magnetism generally has also been investigated. Careful experiments on both induced and residual magnetism have led the author to conclude that (within the range dealt with by him) there is no perceptible hysteresis in the relation of magnetism to temperature. Curves are also given exhibiting the process of magnetising the same piece at different temperatures. These cross each other in the same manner as the corresponding curves for different values of stress, a fact to be anticipated from the earlier discoveries of Baur.

WIMSHURST'S ELECTRIC MACHINE

WE illustrate on the opposite page a machine which has just been completed by Mr. Wimshurst in his own private workshop, and which is, says *Engineering*, undoubtedly the most powerful and efficient electrostatic machine in existence. This apparatus has been constructed for and presented to the Science and Art Department at South Kensington, by Mr. Wimshurst, the cost of the raw material being defrayed by the department.

On reference to the illustration it will be seen that the form of this machine is nearly identical with the well-known smaller type, its points of difference lying in its size and in the construction of the supporting parts, which the greater weights have necessitated. Thus, while the diameter of the circular plates of the smaller machine was 14½ inches, that of those of the great machine is 84 inches; the former being cut out of ordinary window glass, while the latter are discs of plate glass ⅜ inch in thickness, and weighing 280 lbs. each. Each of these discs is pierced at its centre with a hole 6½ inches in diameter, and is firmly attached to a gun-metal boss 15 inches in length, carrying the disc at one end and a pulley at the other, and which is bored so as to run freely on an iron tube 3 inches in diameter, this tube being supported at each end by strong oak trusses, rising from a firm base, also of oak, and which is fitted with lockers at each end, for holding spare parts and accessory apparatus. The heads of the two trusses, or A frames, consist of massive castings of gun-metal, which are so shaped as to hold the hollow iron tube and the ebonite rod to which the collecting combs and discharging terminals are attached. The iron tube projects at each end beyond the trusses, and to the projecting ends are attached the brass "neutralising" rods, which terminate in light wire brushes, shown in the illustration.

To the discs, which are well varnished with an alcoholic solution of shellac, are attached, at equal angular distances apart, radial sectors of tinfoil, 16 on each disc. These sectors are 19 inches long, and have a mean width of 1·65 inch, thus having an area of 31·35 square inches. There is thus on each plate a metallically coated area of 500 square inches, or a thousand square inches on the two discs together.

The apparatus may in principle be regarded as a sort of double-acting "Nicholson's revolving doubler," the sectors on the one disc acting as inductors on the other, and *vice versâ*, and that the extraordinarily high efficiency of the machine is probably due to the fact that both plates contribute charges of electricity to the collecting combs, and that the sectors on the one disc act as inductors and as carriers respectively to those on the other when they approach the best positions for those respective actions to take place.

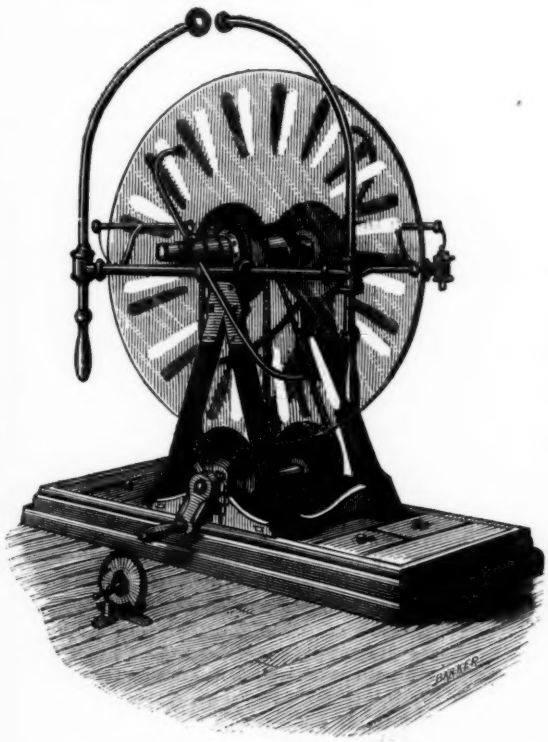
The collecting combs are attached to the discharging terminals, as shown in the engraving, by interchangeable brass rods, some being straight, while others are bent, so that their positions with respect to the horizontal diameters of the discs may be varied within a range of about 16 inches, that is to say, between about 8 inches above and 8 inches below the horizontal diameter. The discharging rods or terminals are constructed of brass tubes 1¼ inches in diameter, and are fitted with terminal balls of different diameters, which are also interchangeable. The distance of these balls apart—and therefore the striking distance of the spark discharge—can be varied by the glass handles with which the discharging rods are fitted at their lower ends, and as these handles have their attachment in a hinge-joint, they can be used as levers wherewith to turn the terminal rods around a vertical axis, and thus to vary the distance between their upper ends.

The two discs are rotated in opposite directions by the lower driving gear shown in the figure; this consists of a horizontal spindle fitted with a winch handle at each end, and carrying a pair of oak pulleys which are connected respectively to the two pulleys attached to the discs by endless cords, one of which being crossed, causes one disc to be rotated in the opposite direction to the other; and as the height of the bearings of the lower spindle is adjustable, the driving cords can always be maintained perfectly tight.

The principal characteristics of this form of electrostatic machine, and to which its exceptionally high value as a laboratory instrument is due, are (1) that it is readily self-exciting in almost every condition of the atmosphere; (2) that the polarity of the apparatus never changes, as it is so liable to do in other forms of

induction machines; (3) that the charge is very large compared with the area of the glass employed in the discs, and (4) the small cost at which the machine may be constructed.

Although the great machine which we illustrate in this notice was working in a workshop in which there was a steam engine and boiler at work, and consequently with a considerable quantity of water in the atmosphere, and although it was closely surrounded with lathes and shafting and other metallic conducting bodies, not only did it pick up its charge even before a complete revolution was made, but kept up a constant stream of discharge sparks between its terminals of over 14 in. in length. The results have already proved far more satisfactory than was anticipated before it was tried, but when it is set to work at South Kensington, and where it will be under far better conditions for developing its full powers, still higher results may be expected. We may, indeed, congratulate Professor Guthrie and the science schools generally on this new acquisition to the physical laboratory, which must prove a most valuable instrument for experimental research.



Mr. Wimshurst has in his laboratory what is probably the largest collection of the most powerful electrostatic induction machines in existence, having worked for several years in perfecting this class of apparatus. We have in the illustration introduced (partly to serve as a comparison of size and partly to illustrate a very interesting and typical form of the apparatus) a sketch of what is perhaps the simplest and the cheapest electric influence machine ever constructed. This little apparatus consists simply of two discs of varnished glass 12 in. in diameter, fitted with tinfoil sectors, and mounted on a spindle, which can be held in the hands, and the discs can be rotated in opposite directions by spinning them with the finger and thumb. When this is done—although there are no collecting combs or discharge conductors—the most brilliant effects can be produced, the whole apparatus literally bristling with electric discharges immediately the rotation commences, and one of the most remarkable and not the least valuable features of this beautiful little instrument lies in the fact that it can be constructed in a good saleable and workmanlike manner and sold at a very small charge.

ELECTRICAL RAILWAYS.

IT is to be hoped that the electrical transmission of power will now receive more attention in this country than has hitherto been the case. In New York much interest is centred on the problem of operating the elevated railways in that city by means of electrical energy, and our transatlantic contemporaries have recently published the views of several well-known experts concerning the feasibility of the scheme.

Although the bulk of the information to hand appears to be more imaginary than real we think that certain portions are, at least, interesting enough to reproduce.

In a letter to Cyrus W. Field, Prof. Moses G. Farmer gives the following summary of the history of electro-locomotion:

In 1839 Jacobi, at St. Petersburg, constructed a boat which he propelled upon the river Neva with a two-horse power electro-magnetic engine, actuated by a Grove battery which had in it twenty square feet of platinum surface.

In 1842 Davidson, of Scotland, constructed a five-ton electric locomotive, which he propelled at the rate of four miles per hour with seventy-eight pairs of zinc and iron in sulphuric acid solution, the plates being thirteen inches square.

In 1847 I constructed and exhibited in public an electro-mag netic locomotive, and with forty-eight pint cup cells of Grove nitric acid battery drew a little car carrying two passengers on a track a foot and a half wide.

In 1850 Page, of Washington, constructed an electro-magnetic engine of 16 H.P., and with a hundred cells of Grove nitric acid battery, each having platinum plates eleven inches square, he propelled a car carrying a dozen or more passengers on the Washington and Baltimore railroad at the rate of nineteen miles per hour.

In 1851 Thomas Hall, of Boston (then at work for Daniel Davis) constructed, and later exhibited at the Charitable Mechanics' Fair in Boston, a small electric locomotive which took its current from a stationary battery by means of the rails and wheels, as the following extract from a letter written to me by him, November 25, will show: "In the year 1851, when I was at work for Daniel Davis, I made a small electric locomotive, which ran on a straight track about 20 ft. long. The wheels were insulated and the electricity was conveyed to the engine by means of the rails from two Grove batteries. The cut-off was in the engine and worked automatically or by hand, so that when the engine reached the end of the track, the switch reversed the engine and it went back to the starting point. In 1860 I exhibited in the Mechanics' Fair a small locomotive called the Volta, very finely made and finished, which ran on a circular track about 8 ft. in diameter. The current was conducted to the insulated wheels from two Grove batteries by means of the rails. I have a part of one of these engines on hand now, and photographs of the Volta; also woodcuts of the first ones which were published in a catalogue between 1851 and 1860."

These four engines, therefore, of Davidson, Farmer, Page and Hall could be started and stopped, sent forward or backward, at the pleasure of the engineer.

In 1859 I conceived of the self-exciting dynamo, which I constructed in 1866 and which was also conceived of by Wheatstone, Siemens and Ladd in 1867 and by Gramme in 1871, so that by 1871 cheap electricity became possible, and nothing more was needed except to substitute the dynamo machine for the galvanic battery to make electro-locomotion both possible and cheap, and yet the invention slumbered on for a decade or more.

Now, in 1884, a host of inventors, by simply substituting the now well-known dynamo for the more expensive and troublesome acid battery, appear to be just on the eve of bringing to blossom and fruitage those buds of promise after their long forty years of germination, because there was then no demand, no elevated roads, and so they came not forth.

There are two principal methods of propelling an electric locomotive: 1st. The engine carries its source of electricity, such as a galvanic battery, as did Davidson's, Farmer's, and Page's. 2nd. It is picked up from a stationary source by means of the wheels and rails, as did Hall's.

In the later days, since the advent of the storage battery, the supply of electricity can be economically carried on a tender, and it is worthy of very patient and long experimental inquiry, which method is the cheaper—to lay a third rail to carry the current to the locomotive, or to charge the storage battery, place it on a tender and attach it to the locomotive.

In a subsequent interview, Prof. Farmer gave further details of his personal experience, as well as his opinion of practical success in the proposed application of electricity, which is reported as follows:—

"And have you retained your faith in the practicableness of operating railway trains by electric motors?"

"I have, and there is reason to expect that its demonstration will soon be witnessed on the elevated railways."

"How would you advise the Manhattan Company to proceed to effect that result?"

"In the first place much skill will be required in the test for the selection of a motor."

"But has that not been provided in the expert commission choosen to appraise and consolidate the rival motor interests?"

"Yes, the members of the commission are satisfactory, if only they will serve, but I do not see how Sir William Thomson can spare the time for the service, unless he is offered a great pecuniary inducement. However, it may take six months to prepare the track and motors, so that he can devote his summer vacation to it. It might take 60 days for the test after all is ready."

"Have you studied the elevated railways with a view to the change from steam to electricity?"

"Yes, I have had my assistant examine the Ninth and the Third Avenue lines. It seems that there are frequently 20 to 25 trains on each track at one time, and each locomotive has about 40 H.P. they say. Of course it will require 20 times as much electricity to move 20 trains as it would to move one train."

"How much cheaper will electricity be than steam power?"

"It all depends upon the system used. There ought to be no difficulty, however, in saving 100 to 140 lbs. of coal per hour on each of the 40-horse locomotives now in use if their consumption of fuel has been correctly represented to me. Stationary engines are much more economical than locomotives, and in Lowell, Mass., a steam pump is operated by only 1¾ lbs. of coal per H.P. per hour, and I have no doubt the Manhattan Company can save much labour as well as fuel by the proposed change."

"Do you expect to see electricity substituted for steam on surface railways?"

"The problem becomes more difficult when transferred to surface lines, certainly, and I am not prepared to say what I expect, either as to the great freight and passenger railways, or as to the street car lines of cities."

"Do you believe, like Mr. Edison, that some one will discover how electricity can be generated directly from coal?"

"The thermo-electric battery to which I devoted so much attention, especially from 1865 to 1868, was too expensive, and it converted not more than three-tenths of 1 per cent. of the energy of coal into electricity. One of my batteries cost $1,000, and was used to apply the copper to the first compound wire ever made, but it gave no key to the economical production of electricity directly from coal, nor has any other contrivance of which I have yet heard."

Prof. Morton, President of the Stevens Institute of Technology at Hoboken, is reported as saying:—

"I think some of the electricians are wild in their estimates, but I am convinced that electricity can be advantageously introduced on the elevated railways of New York. I have read the recent newspaper articles on the subject, and while I think it necessary to make a large allowance for exaggeration, I heartily concur in their general conclusion that the scheme to substitute electricity for steam as motive power on the lines of the Manhattan Railway is perfectly feasible. I should not put the maximum of saving at more than 30 per cent., and the actual amount might be much less. I see that most of the men who have motors to introduce make the minimum about 30 per cent. and confidently predict a saving of 50 per cent. I should say that the cost of generating steam in a stationary engine and in a railway locomotive is as one to two. Clarke, a very high English authority, gives as a result of numerous experiments what is equivalent to five pounds of coal per H.P. per hour as the efficiency of locomotives, and recent experiments of the Pennsylvania Railway support his conclusion. As I have said, the plan to operate the elevated railways by electricity is perfectly feasible, and the economy of the new system would doubtless be very important, while the removal of smoke, dust, and some other disagreeable features of the present system would of itself afford adequate compensation for the change, were there no pecuniary advantage to be derived from it."

"Siemens uses a dynamo as a motor on the electric railways in Berlin and other European cities, and each of the rival motors is a dynamo in a modified form."

"Is there danger in its use?"

"No, and the current of electricity required would not be strong enough to do injury, either by causing fire or shock. Care should be taken, however, to secure uniformity of current, and there is a great difference of the dynamos as to the production of a uniform current. A force of 1,000 volts, if the current could be made uniform, would not be unsafe, I think, but, of course, no such force is contemplated in the estimates of the owners of the motors."

"Is a third rail necessary?"

"It would be possible to use one of the ordinary rails to carry the current and the other to return it, but this would require insulation of the rail and of the car wheels, making the problem more difficult. An insulated third rail for that service would be much better. I do not believe that electricity can be profitably substituted for steam on ordinary railways, at least for the present. Improved methods of generating electricity may ultimately make the change economical, but science has not yet made electricity available as motive power for railways, except on short lines. It is absurd, too, for electricians to talk of applying electricity on surface lines without an insulated track. Much of the calculation of enthusiastic inventors will be found seriously at fault in practice, I fear. Short lines which have numerous trains can be successfully operated by electricity, but the same cannot be said of ordinary surface lines."

Prof. Charles R. Cross, of the Massachusetts Institute of Technology, said:—

"There is much disagreement, even among experts, as to the methods of testing electrical apparatus, and it is difficult to secure an agreement as to the comparative merits of electrical machines. However, the Philadelphia Exhibition did much toward the establishment of correct methods of making tests, and I regard the testing of dynamos there as the most satisfactory work of the kind yet done. It will be more easy for the expert commission to perform its allotted task because of the tests made at Philadelphia, but it may require considerable time to determine what motor is best and what system should be introduced."

"I will say that I think electricity can be advantageously substituted for steam on the elevated railways if anywhere, but there are so many things connected with the enterprise which are yet to be determined that I am not willing to express any opinion as to the results of the experiment."

"You may say that I think the change from steam to electricity will be advantageous pecuniarily, but I will not venture any prediction as to the per cent. to be saved. I think the problem to be considered by the commission is extremely important, both scientifically and pecuniarily, and I prefer to hold my opinion in reserve until investigation has removed some uncertainties which now enter into the case."

"What is the chief factor in the problem—the amount of power required, or the cost, or the risk to life and property?"

"Each of the three factors is important, but I do not think there will be danger in the use of electricity to move railway trains if proper precautions are taken."

"What force can be used with entire safety?"

"I should not hesitate to receive the shock of the current used on most of the electric railways now in operation, although their traffic is nothing like that of the New York elevated railways."

"What force would be required, supposing the number of trains on one track at one time to be 25 and the power of the locomotives now in use to be 40 horse?"

"It would be easy to make an accurate estimate, but without going into a careful calculation I should say roughly about 500 volts with a 1,500 ampere current. That would be approximately the equivalent for the steam power now employed, not taking into the consideration the element of waste in heating the wires. It might be advisable to use lower electromotive force and a higher current."

"And as to the cost?"

"That must be ascertained by a test. The problem is to obtain the maximum of energy at the minimum of expense. The earlier dynamos were constructed with a great internal resistance, but that resistance has been much reduced in the recent inventions. The water-wheel gives the greatest per cent. of the original energy, and in some wheels it is as high as 95 per cent., but the recovery in some of the dynamos is said to be as high as 90 per cent., so that the prospect, from an economical point of view, is encouraging."

Mr. Edward Weston, of Newark, N. J., said:—

"I do not wish to appear too sanguine, but electricity is cer-

tainly destined to play a much more important part in the economy of civilised life than most people dream of. The crudity and wastefulness of our principal motor, the steam engine, is very seldom thought of by any except those who have made a special study of the subject. This apparently perfect piece of mechanism wastes nearly 80 per cent. of the energy of the fuel. The dynamo-electric motor would change all this, if we could convert the energy involved in the combination of coal with oxygen directly into electricity. The dynamo machine will convert more than 90 per cent. of the power transmitted to it into useful energy, and good electric motors would certainly not fall far short of it, and the transmission of power I regard as a much more important branch of electrical enterprise than that of furnishing illumination."

"Dynamo stations would be required in districts of convenient size, with wires to transmit the power to consumers. A small dynamo—that is, a motor, which is a dynamo reversed—would be needed by each consumer, but its cost would be less than that of a steam engine of equal power, and it would require no fuel and could be controlled as easily as is an electric lamp."

"Ten H.P. engines and all smaller ones cost their owners more than would their equivalent of power in electricity. The United States Company will extend its business in the transmission of electricity as power for light machinery as fast as possible."

"Your confidence in the electric motor is doubtless sufficient to enable you to give a favourable opinion as to the feasibleness of the substitution of electricity for steam as a motive power on the elevated railways, then?"

"I have no doubt whatever that the change can be made with advantageous results in more than one direction."

"Let me give you a problem. Suppose that on one track of the 'L' there are at one time 25 trains, each drawn by a locomotive of 40 H.P. What will be the force of electricity required as a substitute for the locomotives to move the trains?"

"It depends upon the pressure as related to the current. But a pressure of at least 500 volts can be safely used, with the proposed 70 pound central rail, and with that pressure a current of not quite 1,500 amperes would be required as an equivalent for 25 locomotives, each of 40 H.P."

"What size stationary engine and what dynamo would be required to furnish that force of electricity?"

"It would be unwise to use one dynamo to generate that amount of electricity, and about six dynamos, each of 200 H.P., would be needed. For the operation of these dynamos a stationary engine of 1,200 H.P. would be adequate."

"And what would be the expense?"

"The rule is that a stationary engine of the best kind costs $50 per H.P. annually, and at that rate the entire expense would be $60,000 a year. But there is this difference between a locomotive and an electric motor. The former has only its minimum power at the start, while the latter has its maximum, and so the locomotives need to have 40 H.P., although the average power required may not exceed 25 horse."

"There are great mechanical difficulties in the case, I admit," said Mr. Weston, in reply to a question, "but what great invention has been introduced without overcoming great mechanical difficulties? Only 50 years ago the citizens of Philadelphia passed resolutions entreating the Common Council not to permit the use of gas in that city, mainly because it was thought to be dangerous. The obstacles to the application of electricity as motive power are certainly not greater than were those encountered by the men who established the system of gas light."

Mr. Edison has also given his views upon the subject through the columns of the *Sun*. He says:—

"The application of the electric motor to the car is simple, and could be effected in no time if the men could be found with nerve enough to advance the money. It will need two stations to keep the current on the tracks. I could build one at Washington Park and one near 42nd Street, and keep all the trains in motion without any trouble, including switching and stops. It can be so arranged that all power will leave the trains as they approach on the same track, and so collisions will never occur. Speaking practically, I will take the 160 engines of the Manhattan Company and put half of them in one of the stations I spoke of above and half in the other, to run the dynamos which will furnish a current of electricity. I will then buy enough old rails to reach from the battery to Harlem, and will set them up between the tracks of the elevated road. Wires from the two stations will be connected with this long railing, and the electricity will flow through it. It will be led to the electric motors, and after furnishing power to run the train, will be allowed to escape through the regular rails of the road."

"What will be the saving to the Manhattan Company?" Mr. Edison was asked.

"They will save in the number of employés necessary, for one man at each of the two stations can run 15 trains. One man can run the electric motor. The saving in coal will be very great. They can use more economical boilers than at present. To-day their property is depreciating on account of the great wear and tear. The power is now applied explosively, in jerks. There is a terrible racking of the whole structure. They might as well explode powder all along the line as to run as they do now. Electricity, on the other hand, is a continuous, velvety motion. There is no jar and no wear and tear to the structure."

"How soon can the change be made?"

"As soon as the money is forthcoming. The motor has reached such a degree of perfection that nothing more can be done to it in the laboratory. It is now only a question of mechanical engineering, or a draughtsman's work, to apply the motor to the elevated road. An experiment is likely to be made soon on the Second Avenue line. If they let me put up my centre railing I can run my electric train right in with the others and not interfere with the steam trains."

"Will any other improvements be made in this connection?"

"There is one that ought to be made now, whether they have an electric road or not. I can increase their travel enormously if they will let me put in an electric elevator at each of the stations. Women will not ride because their clothes are so heavy they can't climb those frightfully long stairs. Old men can't get up there. Just think how nice to step on a platform and rise quietly to the station and come down the same way! Thousands who don't ride now would flock to the roads. The people of New York expend 26,250 H.P. in an hour climbing those stairs. The force consumed averages 2,187 per hour for the 12 hours of the day. Let me figure for you. The report of the Manhattan Company says that they carried 50,000,000 people last year. We put these people into pounds, at 150 pounds each, and have 7,500,000,000 pounds. But they must be raised to the platform, which is 25 feet high at least, and that give us 52,500,000,000 pounds raised one foot. The H.P. for an hour is 2,000,000 pounds raised one foot. If all those people were raised to the stations in one hour, that would be an expendi- of 26,250 H.P., and dividing by 12 for the 12 hours of the day we get an average per hour of 2,187 H.P. expended by people in climbing those stairs. Why, that is about one-fifth the total power expended in running the whole elevated road. But people don't seem to mind it much—man is such a perfect motor, you see."

A letter from Prof. Farmer to Cyrus W. Field was recently published in the *Mail and Express*, containing some calculations as to the saving that could be effected on the Second Avenue elevated railway by the employment of electrical energy for operating the same.

Mr. Farmer assumes that a stationary plant can be erected somewhere near the middle of the line, not far from Sixty-Third Street, this plant to consist of one or more stationary steam engines of the best type, capable of developing one H.P. by the combustion of $1\frac{3}{4}$ pounds of coal per hour per H.P. by the use of such coal as does not cost over $2.50 per ton of 2,240 pounds.

He assumes that there are in use on this line 20 locomotives of 110 H.P. each at the busiest hour of the day, and that each locomotive consumes, per H.P. per hour, 5 pounds of coal that cost $4 per ton of 2,240 pounds.

Again, that the rails now in use are of steel and weigh 70 pounds per yard, and that a central steel rail of 70 pounds per yard will be laid for the purpose of conveying the electric current to the motors.

Furthermore that 1 mile of such steel rail will offer about $\frac{1}{3000}$ of an ohm's resistance, and that the aggregate internal resistance of the dynamos concerned in producing the current will not exceed $\frac{1}{3000}$ of an ohm.

He takes it for granted that from this central station sufficient current will be supplied to both tracks to energise at the same instant all of the 20 electric locomotives, no matter on what part of the tracks these motors may be situated.

He states that 1 H.P. is the equivalent of 746 ampère-volts, and that $20 \times 110 \times 746 = 1{,}641{,}200$ ampère-volts, in the aggregate, reach these motors.

He feels assured that such dynamos can be constructed as shall convert 90 per cent. of the mechanical power applied to them into current electricity, and he also assumes that such electric motors can be constructed and used as shall convert 90 per cent. of the electricity which they receive into power used to draw the trains which are attached to them.

He assumes the Second Avenue Railway to be 6½ miles in length, and has therefore calculated the following tables:—

TABLE I.

Volts.	Present power.	Future power.
500	2,200	3,369
1,000	2,200	2,879
1,500	2,200	2,787
2,000	2,200	2,757

Table I., column 1, contains the electromotive force developed by dynamos at the central station; column 2 contains the H.P. required by the 20 locomotives; column 3 contains the H.P. that must be used at the central station in order to deliver at the electric locomotives the equivalent of 2,200 H.P.

Table II., column 1, contains the electromotive force, as in the first table; column 2 contains the hourly consumption of coal by the 20 locomotives now in use —5 pounds per hour per H.P.; column 3 contains the amount of coal consumed by the stationary engine that developes 1 H.P. by the combustion of 1¾ pounds of coal per hour; column 4 shows the saving in pounds of coal per hour made by substituting the better engine, the dynamo, the electric motor and the rail circuit.

Table 3 shows the hourly saving in dollars and cents by the substitution of electricity thus applied for the coal now used in the locomotives.

It will be seen from this last table that the lower and safer electromotive force of 500 volts is only about 9 per cent. more expensive than the four times as great 2,000 volts, and about 7 per cent. more expensive than 1,000 volts.

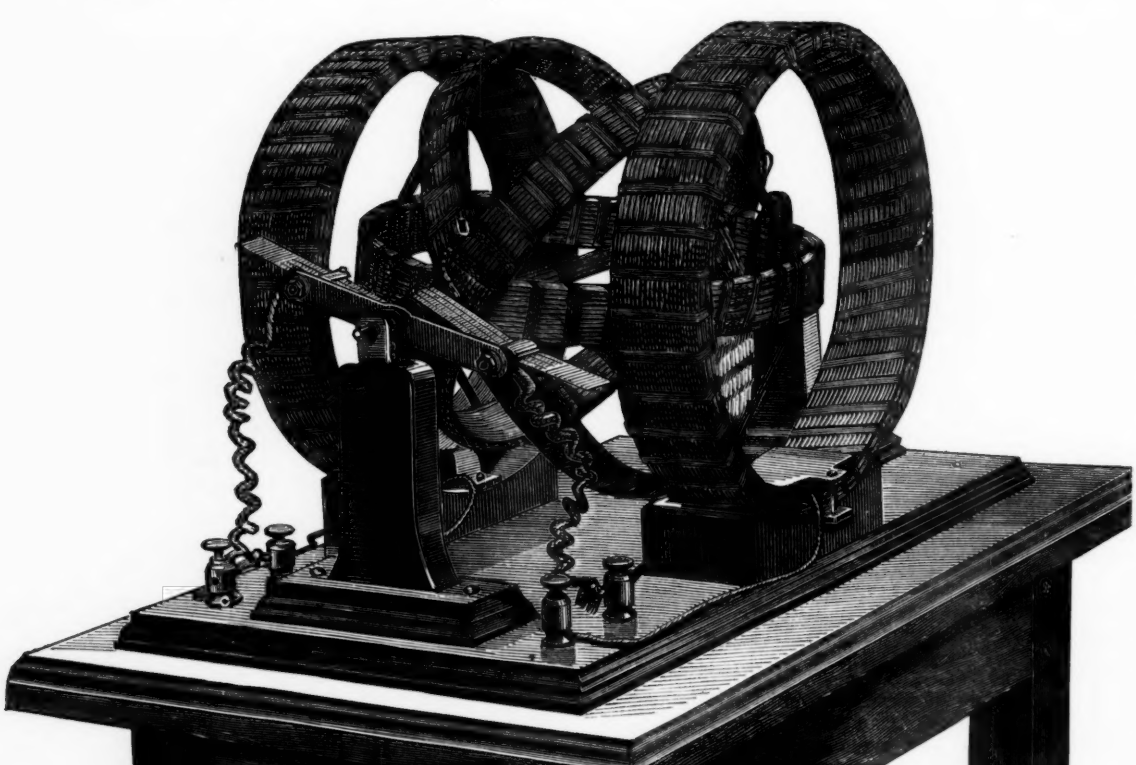


TABLE II.

Volts.	Present coal.	Future coal.	Saving per hour.
500 ...	11,000	5,896	5,104
1,000 ...	11,000	5,039	5,961
1,500 ...	11,000	4,889	6,111
2,000 ...	11,000	4,825	6,175

TABLE III.

Volts.	Present cost.	Future cost.	Saving per hour.
500 ...	$19.65	$6.58	$13.07
1,000 ...	19.65	5.62	14.03
1,500 ...	19.65	5.46	14.19
2,000 ...	19.65	5.38	14.27

THE THOMSON-HOUSTON ELECTRO-MOTOR.

IN one of our articles on the late Exhibition held in Philadelphia we dealt very fully with the Thomson-Houston dynamo and electric lighting system generally, and we mentioned that amongst the exhibits of these gentlemen was to be seen a small Thomson dynamo running as a motor.

In addition to this there was shown a skeleton model of this dynamo, constructed of wire coils without iron. The three coils of the armature were simple hoops of a few turns, and those representing the field-magnets were also simple hoop-like coils. These were mounted in the same relative positions as in the complete machine, and the skeleton apparatus thus produced, when put in circuit, revolved as a motor with great rapidity.

The drawing, as shown above, represents a general view of the Thomson-Houston electro-motor, and the

armature is in the general form of a sphere, but the details of construction are different from those of the dynamo armature.

The coils both of the armature and of the field are made entirely of the conducting wire.

The principal part of the invention in this motor is in the method of winding and connecting up. We notice in the New York *Electrical World* that the Brotherhood engine suggested the first conception of the idea of winding the armature. It is a well-known trouble in motors, as well as in steam engines, that often when the driving force is turned on the motor will not work until it is started by some outside auxiliary assistance so as to get over the "dead centre."

From the very form of the armature and its method of winding and connecting up it will always begin to turn just as soon as a current is passed through the motor. The armature consists of three coils. The current does not pass through these in series, but in multiple arc, so that it may more properly be called an armature of three branches extending from a common centre than a three-coil armature. The three coils incline to each other at angles of 120°.

The commutator is so arranged that for any position of the coils two of them only are in multiple arc at a time, so that there is always an unbalanced force between the armature coils and the field coils when the current is on. Although at one end the wires of these helices are in contact their separation at the ends leading to the commutator and the brushes prevents the completion of a conductor which would short-circuit the armature.

From the above description it would appear that iron cores do not enter into the construction of this apparatus at all. We have not seen any details of its performance or efficiency, but we doubt whether such an arrangement is capable of doing any heavy work, that is, if we are correct in assuming that its motion is produced simply by the action of electric currents upon each other.

TRAIN LIGHTING BY ELECTRICITY.

IN continuation of the correspondence on this subject in the columns of a contemporary the following letters have appeared, and, as before, we reproduce them for the benefit of our readers :—

Mr. W. H. Massey, after repeating that he is not pecuniarily interested in any railway carriage lighting scheme, says :—"Mr. Langdon may fairly be said to represent those railway authorities who in their anxiety to keep us *always* well lighted never give us any light worth mentioning. We have to take long journeys in the dark (unless we provide ourselves with candles), and yet the people who show such a grandmotherly interest in us hesitate to avail themselves of an excellent and very cheap light lest we grumble at its being extinguished occasionally, and for a few moments only, at stations where even now we manage to do without it, as any one may see for himself if he will watch a person who has just taken his seat, for in nine cases out of ten such a person will read his newspaper by the light which the platform lights give and not by the rushlight arrangement in the roof of his carriage. As soon as the train leaves the station two-penny candles come into play. In all my experience as a railway passenger, and I travel about this country a great deal, I have never come across an unbiassed individual who objected to put up with some slight inconvenience, at well-known stopping places, if he could thereby secure for his journey what we have been in the habit of calling a light; and I am decidedly of opinion that the public would gladly 'submit' to such an improvement as the lighting of a train by means of a small engine placed on a locomotive would undoubtedly be. Messrs. Heenan and Froude's plausible remarks would prove dangerous in the hands of less scrupulous men than themselves; men whose object it might be to throw sand in the eyes of railway people who are generally unable to settle nice engineering points, and few of whom can see clearly that it is physically impossible for an engine to require less fuel than is used to evaporate the water supplied to it as steam. To pretend to base calculations of cost on an increased consumption, which must be very difficult to arrive at, instead of on the amount of steam an engine actually uses, may be Commerce, but it is not Science. There are many cases in which 'it *may* be worth while to sacrifice *some* economy of fuel in order to economise space;' not on a locomotive, however, for although the 'available places for placing an engine and dynamo are not unlimited,' the places are large enough to hold something bigger than a Tower engine and a Crompton dynamo. This is *the* case of all others in which it is worth while to sacrifice *some* useless space in order to economise valuable steam, because the cost of producing it will be the chief item in a railway company's bill for electric lighting; and it is only by using the most economical type of engine that the electric light can be supplied for less money than is now paid for compressed gas lighting. Much has been said about the bulkiness of the plant used in the District experiments, and I should like your readers to know that nearly 18 months ago I could have placed a Siemens 60-light dynamo, and the Willans engine afterwards used to drive the 120-light machine, in a wrought-iron casing 4 feet long, 15 inches wide, and 3 feet high. This casing could also be arranged to hold 100 yards of cable, 100 yards of branch wires, 50 spare lamps, 6 gallons of oil, a good store of cotton waste, a box containing hammers, files, chisels, spanners, spare commutator brushes, and a complete set of electric light tools; but the railway officials and others maintained that it was better to ascertain the probable cost of the light than to design compact pieces of mechanism, and I am not ashamed to own now that they were right. The price of the engine was £45, the 60-light dynamo £75, and the expense of fitting up a long train would not exceed £50 more. Will Mr. Crompton say how this compares with what he has recently done himself?"

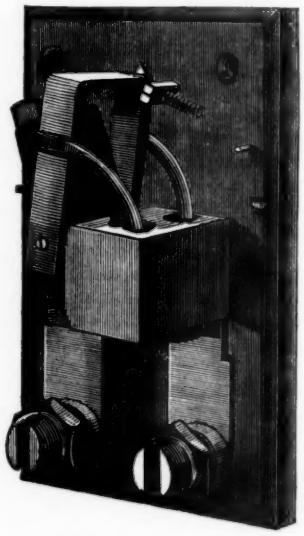
Mr. P. W. Willans, having observed that a previous letter of his has been rather severely criticised, especially the paragraph: "Few engineers will be found ready to take as a basis, for the comparative cost of two systems, the increased coal consumption in a large locomotive boiler, when a 5-horse power engine is at work driving the lights," writes :—"I am afraid I did not make this as clear as I might have done, although I doubt whether any unprejudiced person could have misunderstood me. What I meant was that the quantity of steam used by the lighting engine is small as compared with that taken by the locomotive itself, and that the chances of error in coal trials are great. In arriving at the cost, it is far safer therefore to measure the weight of steam used per hour in the lighting engine alone when fed from an independent boiler, and then, the evaporative efficiency of locomotive boilers with various kinds of fuel being fairly well known, the cost of the power can be determined with some approach to accuracy. Messrs. Heenan and Froude's argument is a very poor one indeed, for even assuming that in the use of the axle-driven dynamo, there is no reliable way of arriving at the power absorbed, and that there is no choice but to make a rough estimate of the extra coal burned—that surely is no reason for adopting the same course in the case of a dynamo driven by an independent engine, the steam consumption of which can readily be ascertained. The way to convince the public is to put hard facts before them, and that system will have the best chance in which there are fewest unknown quantities. I was surprised to see how many things my letter 'naturally infers.' Knowing Mr. Crompton well I certainly never doubted his ability to find out the steam consumption of a motor at his works, and having found it out there I am sure that he would be the last man to prefer the comparatively rough estimate which the most careful locomotive driver could possibly make. I had no wish to detract from the credit due to Messrs. Heenan and Froude or the Tower engine. The skill displayed

in its design and its beautifully smooth running must command the admiration of that firm's keenest rivals; and I hope most sincerely that their energy and perseverance in this train lighting undertaking will meet with the reward they merit. I took exception to Mr. Crompton's letter of December 26th, so far as it could be understood to mean that Mr. Massey had used the best machinery procurable at the time of his experiment, or that space even for the engine then used could not be found on a locomotive. When I saw Messrs. Heenan and Froude's letter I was aghast, for they say, 'Mr. Willans says that he could keep his engine within the same floor space and within a limit of 12 in. in height.' I said nothing of the kind, my words being, 'The floor space occupied by my engine was not more, I think, than that occupied by the Tower engine, and its height, although more than 12 in., would not be too great for the tunnels.' I agree with Messrs. Heenan and Froude that economy of fuel is not the only consideration, and I think I may ask them to admit that a few inches more or less in height cannot seriously affect the question either. They go on to say, 'We think this statement' (alluding to the purely imaginary one which they put into my mouth) 'would have come with more force if he could say he had positively designed a complete apparatus within our dimensions.' There appears to be some uncertainty about 'our dimensions,' which led me to use the words, 'I think.' I may say frankly that the only train lighting undertaking with which I have so far had any connection, was the experiment on the District Railway, and as my part was that of the contractor for the machinery under the Swan Company, it was not open to me to use for my own advantage the experience which I then gained until they let the matter fall through. As my own contribution to more exact figures, I may mention that the base of the compound engine used in the above experiments measured 15 in. by 14 in., and that the consumption of steam was at the rate of 29 lb. per horse power per hour. A simple engine would of course have been smaller."

Mr. R. H. Froude states that Mr. Langdon, in his letter of January 9th, takes very decidedly the view taken up by many, that there must *not* be an interval during which the lights are extinguished, and contends:—"It is easier to do what others require (if they require what is practicable) than to persuade them into not requiring it; therefore we are arranging one train with accumulators. But with regard to the necessity of avoiding interruptions *absolutely*, I should like to mention three experiences of my own:—(1) I saw an express train about to leave a terminus and passengers entering and taking their seats ten minutes before the lamps were put in, and, no doubt, this was a matter of daily occurrence. (2) I remember frequently lamps being changed at a principal station, and no remark made at the inconvenience suffered from a temporary cessation of the light. (3) When making a night journey I have drawn the blinds over the lamp of the compartment, in order to make it dark to promote sleep, and passengers entering and leaving the compartment at the stations have left the darkening blind untouched. If it were decided in the course of time to adopt electric lighting in trains and do without accumulators, it would be very easy to alter somewhat the disposition and height of the station lights so that they might shine well into the carriages. The real occasion when the cessation of the light becomes serious is in a "slip" carriage, and in the case of a carriage detached to be shunted to another platform and perhaps left standing on an outlying siding for some considerable interval. The accumulator may be the best solution of these cases, but if these intervals of total darkness form a small proportion of the time during which passengers are in the carriage, it is worth remembering, there *are* the old receptacles for the oil lamps and the lamps could be inserted for the few isolated cases when they are required. In a slip carriage of course the lamps would be lighted and put in place at the last station at which the train stops before the point of detachment."

AN AUTOMATIC (TUMBLER) CUT-OUT.

ONE of the first means of obviating the over-heating of insulated wires was the use of small pieces of lead wire or, as they have since been called, "fusible cut-outs." These were afterwards improved upon by several makers, notably Mr. Killingworth Hedges and Messrs. Woodhouse and Rawson. The former, in the place of lead, used an alloy, which was rolled out into very thin strips and cut into shape, and these strips were protected from mechanical injury by thin pieces of mica. The ends of the strips of alloy passed under pieces of brass screwed down tightly upon them, and upon more current passing through them than they were designed for, they were melted and the circuit broken. Messrs. Woodhouse and Rawson's fusible cut-outs were of the same nature, except that the alloy was fastened on vulcanised fibre and stamped out to the shape required, the face with the foil attached being placed downwards, thus guarding it from mechanical injury. Contact was made by two screws, screwing on to the vulcanised fibre pressing the alloy on to pieces of brass.



There are, however, many grave objections to the use of these fusible plugs, so Mr. Cunynghame, the author of the well-known book on "Electric Lighting," and Messrs. Woodhouse and Rawson have lately brought out an automatic cut-out, which is used by them in all cases where it is required to sever or make an electric connection on the current or E.M.F. exceeding or falling below a given strength. Its action depends upon the raising of an armature against the action of gravity when the current passing round a small coil exceeds what the instrument was adjusted for. On the armature being drawn up, it draws two copper legs out of two mercury cups and thus severs the connection. The moment before the connection is severed, the armature falls over by its own weight to the other side and completely breaks the circuit. Two legs can be put on to the other side to fall into mercury cups and put in a resistance, ring a bell, or do any other work required. A small screw enables the instrument to be set for any current which the size of the wire on the coil allows. A touch of the finger, or a mechanical arrangement to act after a few moments, restores the connection when it is broken. In fixing the instruments the only precaution needful is to level them; they will then remain in perfect order for years. Little or no electric energy is consumed or lost by the apparatus, as happens with the fusible cut-outs, which, if the current passing through them is anything near the breaking point, get extremely hot and offer an increased resistance, thus wasting energy. The

advantages of an efficient automatic cut-out in connection with ship lighting are particularly apparent, and a special form in which a spring action is used in place of gravity, is made for such purposes.

Our contemporary the *Mechanical World* says:—"We have successfully tested the apparatus with currents of 60 to 80 ampères by altering the adjustment by means of the screwed stop to the correct position as indicated by the pointer at the back of the armature, and might have varied it so as to break the circuit at any current strength up to 100 ampères but for lack of capacity in the circuit on which we employed it."

TELEPHONY IN FRANCE AND IN ENGLAND.

THE Paris correspondent of the *Times* contributed to that journal on Saturday last an interesting account of the progress of telephonic communication in the French capital. He says:—"The working of the telephone in France, and especially in Paris, has been granted by a concession of the State to the Société Générale des Téléphones, and the extension of the term deserves notice now that social intercourse has been revolutionised by the use of this invention.

"It was generally thought that the Minister of Posts and Telegraphs would assume the working of it on the part of the State. Apprehensions on this score were entertained, and would certainly have arrested the diffusion of the telephone in France. There is in this country a latent dread of State inquisition, and everybody is persuaded that if the telephone were in the hands of the State verbal communications would cease to be a secret between the two speakers. No doubt this fear is groundless; but it is explained by the unceremoniousness with which the State takes cognisance of private telegrams; and foreign senders, especially from England, do not recollect that a non-ciphered telegram to any well-known personage is known to the Government before it reaches its destination. It was therefore with some apprehension that the termination of the company's present term was awaited.

"As there is nothing harder to eradicate than prejudice, it is fortunate for the progress of the telephone and the satisfaction of the public that the concession of the Société Générale has been renewed for five years. Although, with his ordinary sagacity, M. Cochery has reserved the right of the State to take over the enterprise, the way in which the present company shall acquit itself of its duty will probably determine how long the public will enjoy immunity for its verbal communications from the ever-dreaded intervention of the official ear. No doubt so long as the Ministry of Posts and Telegraphs is confided to the scrupulous direction of M. Cochery no such apprehension need be entertained; but in a country of incessant changes, where a Government inspiring confidence may be succeeded by one creating alarm, the public would not feel perfectly safe unless the often confidential and important dialogues passing through the telephone were safe from all official auditors.

"It is interesting from this standpoint to study the organisation of the telephone service, which daily plays a more important part here, and the abolition of or interference with which would derange the habits of all Paris. The company possesses a central office, corresponding with 12 branches scattered over the city. With but few exceptions, the communication, which passes by the district office to the central, and thence to the person wanted, is obtained in from 30 to 40 seconds, and if this time be exceeded the delay is owing to the correspondent asked for not replying at once. The number of subscribers in Paris, according to the most recent statistics, is about 3,700, of whom 3,550 have communication and 150 are on the point of receiving it. The number of calls is on an average during the winter months 24,000 a day, and 1,000 a night from 7 in the evening to 8 in the morning, which gives an average of seven calls a day per subscriber.

"As the subscription is 600 francs per annum, or two francs for each working day, a call costs on an average 28½ cent. No telegram is so cheap or convenient as this, and the time taken for the delivery of a telegram averages an hour, whereas communication through the telephone is almost instantaneous. The rates, however, are considered high, and everybody expected a reduction in the new concession. This has not been made, the reason probably being that the Minister wished to avoid too keen a competition with the State telegraphs, and in view of the possibility of the State taking over the telephone, desired likewise to guard its liberty of action.

"The company's double wires are more than 5,000 kilometres in length. This double wire system, introduced a year ago, is one of the greatest improvements which the company has effected. Great inconvenience had been felt owing to the passage from one wire to another of communications and external noises. Many experiments were tried to remedy this 'induction,' and others will still be made; but at present the double wire system has been the most successful, and, except when some clerk is negligent or incompetent, the sounds are transmitted in Paris with wonderful purity and ease.

"As to the rates, the company's view is that the rent paid to the city for the use of the sewers and the 10 per cent. of the gross receipts paid to the State amount to about 25 per cent. of its earnings, while a marked reduction would bring such an influx of new subscribers that the lines could not for a long time be properly worked; besides which the telephone would be perverted into an amusement for idle people. The company now employs 200 persons, at salaries averaging 150 francs or 160 francs a month, lunch being provided for them.

"Fresh efforts have lately been made to accommodate the public without reducing the rates. Fifty telegraph offices will have telephone compartments, some of which are already fitted up; and for 50 cents per five minutes a person may go and converse with a subscriber, or with anybody, at another office, with whom he has made an appointment. This system will steadily extend, and, although only begun three weeks ago, there has been an average of 60 communications a day. A person proposing to make a call will then, by going to the telegraph office, ascertain whether his friend is at home, and, if not, will save a useless drive.

"Another improvement suggested by M. Cochery, and agreed to by the company, is the establishment of a telephone station at the central telegraph office, so that for 50 francs a year, not including, of course, the charge for the telegram, a subscriber can telephone a message for transmission by telegraph. This not only saves trouble but saves three-quarters of an hour for a telegram sent abroad, and 25 minutes for one inside Paris. Another great step in advance, though not yet benefitting Paris, is the establishment, as mentioned last night, of telephonic communication between Rouen and Havre.

"I will conclude with a classification of some of the Paris company's subscribers possessing a certain interest, and which will suggest inferences to the reader: Bankers, 234 in 1884, and, owing to the closing of 14 unsuccessful banks, 222 in 1885; brokers, 102; newspapers, 71; printers, 65; cab proprietors, 60; booksellers, 56; engineers, 50; builders, 41: stockbrokers, 37; publicists, 30; clubs, 27; architects, 27; restaurants, 26; railway companies, 26; hatters, 22; insurance companies, 21; barristers and solicitors, 21; hotels, 21; cafés, 21; theatres, 15; dressmakers, 14; Government offices, 9; physicians, 6; Chinese shops, 3; and embassies, 1, namely, that of Russia."

In its leading columns of Monday the *Times* referred to the communication given above, remarking that it "supplies materials for comparison with what has been effected in the same direction among ourselves. It appears from the account that the Parisians would have made little use of the telephone if it had remained in

the hands of the Government, so that communications might have been audible to official persons who were not intended to hear them, but that the grant of a renewed concession to the Société Générale is thought to have secured the privacy of messages, and that since this concession has been in force the instrument has come into far more general use in the French capital than in our own. The annual subscription in Paris amounts to 600 francs, or £24, against £20 in London; but the Paris subscribers are the more numerous. The total number is now 3,700, the last 150 being not yet supplied with instruments, so that only 3,550 are actually connected with the exchanges. In London, on the 15th of October, the total number of connected subscribers was 3,255, and the average monthly increase for the six preceding months had been 50, so that the total may by this time be 3,405. The average daily number of messages sent through each Paris instrument is seven, while the London Company state that only few instruments have a smaller daily average than five. When the enormously larger size and greater population of London are taken into account, it is manifest that the greater popularity of the telephone in the smaller city must be due, in some degree at least, to a more sagacious policy on the part of those by whom its distribution is controlled. One evidence of this is not far to seek. In London the use of the telephone is entirely restricted to annual subscribers, who have instruments fixed in their houses. The directors of the United Company divide mankind into two classes, subscribers and others—classes as distinct as Greeks and barbarians, as the chosen people and the Gentiles. The directors desire that the Jews should have no dealings with the Samaritans. They issue solemn warnings to their subscribers against the enormity of permitting any miserable non-subscriber to send a message over their lines. A man may be strictly upright and honourable in all his dealings, and the uneventful tenour of his life may be such that the Post Office and the telegraph suffice for his customary requirements; but to the directors of the telephone company he is the merest outcast. If an urgent need for rapid verbal communication with some distant person should by any chance come upon him, it is held that he is rightly punished by being refused the means of gratifying his desire, and that he ought to feel a glow of satisfaction in the thought that he is made useful to his species as a warning and an example. The directors do not even extend a cordial welcome to proselytes, but endeavour to impress upon them that their adhesion should have been notified at an earlier period. After an annual subscription has been paid, the hapless convert is compelled to wait some six weeks for his instrument, and he receives no privileges during his period of probation. The telephone companies have been plundered and bullied by the Post Office, and the directors, like the footman in the 'School for Scandal,' revenge themselves upon any victims from among the public whom chance may throw in their way.

"They manage these things better in France. Our correspondent tells us that in Paris fifty of the telegraph offices will have telephone compartments, some of which are already fitted up, and for fifty centimes for five minutes a person may go and converse with a subscriber, or with anybody, at another office, with whom he has made an appointment. In London a subscribing tradesman can receive orders by telephone only from those persons who are themselves subscribers. In Paris he can receive orders from any resident in the city, and it would clearly be worth while for the London subscribers to put strong pressure upon the company for the sake of obtaining the facilities which are given in France. That it would be in the interest of the company to give them does not admit of doubt; and the warning against permitting non-subscribers to send an occasional message is a pitiable instance of the way in which short-sighted and grasping people may overreach themselves. To the vast majority of Londoners the telephone is only a name. They are thoretically well acquainted with its working, but they have no real practical knowledge of the convenience attending upon its use. The sooner they acquire this knowledge the sooner they will become subscribers. In some emergency a resident in one part of London wishes to communicate quickly with a resident in another part. He would first think of a telegram, but he remembers that his friend is on the telephone exchange. He might run to the nearest neighbour who was in the same position, and, but for the official prohibition, he might be allowed to pass a question and answer over his wire. The answer might need a word of explanation, and this also would pass. The experience thus gained would do more to produce a desire to have a telephone than any amount of reading or of theoretical information. It is unquestionable that, if the non-subscribing public had free access to telephones at the telegraph offices, no retail tradesman could afford to be without a fixed instrument at his place of business."

LEGAL.

Edwards v. The Duplex Electric Light, Power and Storage Company and Others. — This case occupied Vice-Chancellor Bacon several days last week. It was an action brought by Mr. John Edwards, on behalf of himself and all other debenture-holders of the above company, which is now in liquidation, asking in substance to have payment of the debentures enforced. The company was incorporated on the 18th of May, 1882, with a capital of £100,000 in £1 shares, of which about 35,000 were subscribed. By the articles of association the directors were authorised to borrow money on debentures, to issue debentures for that purpose, and to appoint a general manager who might exercise the full powers of the board of directors. At a meeting of the board the defendant, Dr. Emmens, was appointed general manager, and the quorum of directors was fixed at three. In May, 1883, the directors desiring to issue a debenture loan, the defendant Emmens suggested, by way of encouraging shareholders to come forward, that an offer should be made to all shareholders whose shares were fully paid up to take payment for the debentures, half in cash and half in fully paid up shares of the company, and it appeared from an unsigned entry in the company's agenda book, that a board meeting was held on the 8th of May, at which Emmens and three of the directors were present, part of the business transacted being noted thus:—"Consideration of the general manager's suggestion as to an issue of first mortgage debentures. Approved subject to counsel's opinion." From the evidence, however, it appeared that of those three directors one was not present at all, and another did not arrive until after the alleged business had been concluded. On the 12th of May a circular was issued to the shareholders announcing the proposal to issue debentures, and pointing out, with a view of enabling them to realise their shares without being affected by the prevailing depression in the market, that they might, in exchange for £5 in cash and five shares, obtain a debenture for £10, bearing interest at 6 per cent. per annum. Several debentures were accordingly issued on these terms to the plaintiff and other shareholders. On the 17th of May, 1883, a "covering" deed was executed by the company, whereby, after reciting that the directors intended to raise a sum of £20,000 by the issue of debentures, the company, "in consideration of the premises, 'conveyed' the letters patent, the unpaid capital and future calls, and all the undertaking, lands, machinery, plant and effects, whatsoever of the company" to the defendants, Mallard and Emmens, as trustees for the debenture-holders; the deed being registered as a bill of sale. Each debenture contained a reference to this deed. On the 6th of June, 1883, a petition was presented for winding up the company; on the 14th July, 1883, the usual winding-up order was made; and a liquidator was subsequently appointed. The question was whether the debentures operated as valid securities.

Mr. Marten, Q.C., and Mr. Ashton Cross appeared for the plaintiff.

Mr. Millar, Q.C., and Mr. E. Beaumont, for the liquidator of the company, contended that the debentures were invalid on the grounds, first, that their issue had not been sanctioned by the necessary quorum of directors: and, secondly, that the debentures and trust deed were invalid under the Bills of Sale Act, 1882, in that it did not contain a schedule as required by sec. 4, or state the "true consideration" as required by sec. 8.

Mr. Marten, in reply, relied on sec. 17, which enacts that the Act shall not apply to debentures issued by an incorporated company and secured upon the capital, stock, or goods, chattels, or effects of such company.

Mr. Levett, for the defendants, the trustees of the deed, supported the plaintiff.

The Vice-Chancellor said that the object of the Legislature in passing the Companies' Act, 1862, was to protect the shareholders of a joint stock company and to limit and

define the powers of the directors to whom their property was committed upon trust. In the present case the directors were under the articles entitled to borrow any sum of money they thought fit, and to secure the same by the issue of debentures. The company having expended all its money, it appeared from the agenda book that a proposal was made to the board of directors by their manager for the issue of debentures, and that this suggestion was "approved of subject to counsel's opinion." This was the origin of the issue of the debentures. The minute was not signed by any director then present or by any other person. The 67th section of the Companies Act, 1862, required that every company should cause minutes of the proceedings at any meeting to be kept in books to be provided for the purpose, and to be signed by the chairman, and that the minutes so signed should be received as evidence. Here was a distinct breach of that enactment, for he did not find that these minutes bore the signature of any director. In his opinion, therefore, those minutes could not be used as evidence on behalf of the plaintiff. It was said that a previous meeting was held at which it was resolved to raise the loan; but he could find no such thing. Had he found the minutes of that previous meeting confirmed, possibly there might have been some ground for the argument that what was done was sufficient, but he did not find that any such resolution had been passed. There being no such resolution all that was done was illegal and invalid. It was said that three directors were present at the meeting of the 8th May, but that was by no means clear. The evidence was that Illidge, one of the directors, did not appear until after the business was done. He was asked to infer that Illidge crept into the company's office by the private door, but he could not listen to that suggestion. In order to hold that what was done at that meeting was valid he must find a quorum of three directors present and evidence forthcoming of what was done. The utmost that could be said of the minutes was that there was an approval of the manager's suggestions, provided counsel should approve of them, and from the evidence, so far as it went, it appeared that no counsel had advised that the proposals could be carried into effect. No evidence was forthcoming as to what was done under those minutes. Then he had been referred to a circular proposing that each fully paid-up shareholder should, in consideration of £5 cash and £5 paid-up shares, receive a debenture of £10 bearing 6 per cent. interest. That meant this, "You have already, as a shareholder in this company, contributed £5; it is your money no longer; and if you give us £5 more we will give you a mortgage for £10." Was that within the articles of association? In his opinion it was a clear fraud, in the sense of being *ultra vires*, upon the other shareholders, who were to have £5 taken from their joint stock for the benefit of those of their body who chose to pay over £5. The whole thing was, in his opinion, invalid; and even if the minutes of the 8th May had authorised the issue of the debentures in a regular manner the transaction would have been inequitable and unfair, and altogether outside the duties of directors, for it was a contrivance by which witless people would pay the gambling game for this company, by which they would be cheated of their stakes, and would receive nothing but counters and checks in return. This was enough to decide the case, and on that ground he dismissed the action with costs, the whole transaction being a fraudulent contrivance not authorised by the articles of association. He, therefore, did not find it necessary to go into the other question as to the effect of the Bills of Sale Act. He relied solely on the deed executed by the directors, for there was no pretence for saying that there was any intention of raising £20,000. They intended simply to beguile the witless shareholders who had paid £5 and to induce them to better their position by accepting a mortgage for £10. What was the effect of the 17th section, a most sweeping section, of the Bills of Sale Act, 1882, it was, in the circumstances, unnecessary for him now to decide. The case before him was one in which the assets of a company now being wound up had been placed under the protection of this Court, which was bound to see whether the directors had, in dealing with those assets, been acting within their articles of association. In his opinion they had not done so, and therefore he dismissed the action with costs.

Mr. Marten asked that, as the plaintiff was a creditor acting merely in a representative capacity, the costs might be costs in the winding up.

The Vice-Chancellor said it was an unreasonable, illegal, and unrighteous demand against the company, and therefore the plaintiff must pay the costs of the action. As to the trustees, they were confederates, and he should, therefore, give them no costs.

In re The J. B. Rogers Electric Light and Power Company.—Court of Appeal (Tuesday). Before the Master of the Rolls and Lords Justices Cotton and Lindley.—This was an appeal from a decision of Vice-Chancellor Bacon refusing a winding up order on a petition presented by the appellant, the late managing director of the company.

Mr. Swinfen Eady was for the appeal, and Mr. Millar, Q.C., opposed it. The liquidator of the company was also represented by counsel.

It appeared that the appeal had stood over for more than a year, and in the meantime an order had been granted for the winding up of the company on another petition. There was no note of the Vice-Chancellor's judgment, of which fact the Master of the Rolls expressed his strong disapproval. At the petition which came before the Vice-Chancellor, Mr. Rogers put in an affidavit showing that the company had practically ceased to carry on business, that the contract to light the Tivoli Restaurant had fallen through from want of funds, and that an arrangement for the sale of a concession to a Jersey company had fallen through for the same reason. It was shown by the other side that a short time before the petitioner had made an affidavit that the company was in a prosperous condition.

The Master of the Rolls said the Court had before them an appeal against a decision refusing at a certain date to wind up the company. Since that an order had been made to wind it up, and therefore everything that the appellant at the time really wanted had been attained. Nevertheless, that appeal had been persisted in. Well, now, in those circumstances the petition came before the Vice-Chancellor and was refused, as far as he (the Master of the Rolls) could gather, on the following grounds:—1st, that the allegation of the petitioner was disputed; 2ndly, the petition did not appear to be presented for the purpose of enforcing the petitioner's debt but for some indirect motive of revenge; 3rdly, that the insolvency of the company was not sufficiently proved for one reason, viz., that the very petitioner had made an affidavit just before absolutely inconsistent with the one he was then making for the purpose of the winding up of the company. Then before the very same Vice-Chancellor a short time afterwards another petition was presented by a different party and a winding-up order made, which showed that the Vice-Chancellor was perfectly satisfied that the petition was *bonâ fide*. Thus this appeal, bolstered up with the allegations the counsel was instructed to make, was brought before the Court with no possible evidence which enabled them to say upon what grounds the Vice-Chancellor based his decision, and yet they were asked to over-rule it, which, under the circumstances, would be improper and what he for one should refuse to do.

Lord Justice Cotton concurred, and said that in his opinion the petition was not honestly presented for the purpose of obtaining payment of the debt.

Lord Justice Lindley also concurred, and said it was a strange-looking case. Mr. Rogers appeared to have been the promoter of the company, and within 18 months he presented a petition to wind it up.

Appeal dismissed with costs.

Hind v. Russell, Q.C., and Others.—Queen's Bench Division. Before Mr. Justice Wills and a Jury (Tuesday).—The plaintiff, who appeared in person, read at great length his statement of claim. The action was brought against Mr. Russell, Q.C., M.P., Mr. Philbrick, Q.C., Mr. Reginald Brown, and several other members of the bar, and against Lord Alfred Churchill and Mr. Angus Croll, late directors of the old United Kingdom Electric Telegraph Company, Limited, for the alleged procuring of fraudulent judgments in the Courts, and conspiring to cheat and defraud the plaintiff in an action arising out of the sale of the United Kingdom Telegraph Company to the Government. The damages claimed, it was said, were the sum of £100,000. The jury frequently interrupted the plaintiff in the course of his statement by asking that he should state something that was intelligible to them.

Mr. Justice Wills at length said that the plaintiff had put into his claim a large number of charges of all sorts against a variety of people, which could not all be tried together, for the alleged causes of action had nothing to do with each other.

Mr. Hind, after some discussion, said that he would go on with the case against the counsel only, and in answer to an observation of the jury, he said that he could prove it up to the hilt.

Mr. Justice Wills, after hearing a great deal more of the opening speech, said, as he understood, the Court of Appeal held that the statute barred that action. The charge against a particular counsel was that he allowed the Court of Appeal to decide; that he confederated with other people to cheat his client.

Mr. Hind: That was what he did, and he had done it many times. He withheld evidence from the Court that would have proved the case. It was not an unfrequent case, for there were certain counsel who were known as wreckers of cases.

Mr. Justice Wills said that was a scandalous observation upon a number of gentlemen, and it ought not to be allowed to be made except upon material. The charge was one of fraud, and he should hold that if what was done on the part of counsel was done in the honest exercise of discretion, no action would lie, however wrong it might be.

Mr. Philbrick: There was a series of actions begun by Mr. Allen against the company, and to stop all the claims the company went into winding-up. Under that Mr. Allen's claim was carried on; Vice-Chancellor Bacon held against it, and the Court of Appeal upheld that decision. The proceedings did not last a quarter of an hour.

Mr. Hind: No; because you sold us. You never argued it. He contended that the judges were altogether wrong, utterly wrong. There had been a conspiracy between the different lawyers, and the judges had never been able to give an honest judgment.

Mr. Justice Wills intimated that he should hold that no cause of action was disclosed.

After considerable discussion and further extraordinary assertions on the part of the plaintiff,

Mr. Justice Wills: The time has now come for me to pronounce on this matter, for I am satisfied that we have got to the bottom

of the facts upon which you propose to base your charge against these gentlemen. If counsel says that he takes a different view from his client of what is material, and refuses, contrary to the wish of the client, to bring before the Court facts, arguments, and authorities that the client thought material—which was putting it at the highest—there would be no cause of action.

Mr. Hind wished to refer to the Statute of Westminster (laughter), and to "Russell on Crimes."

Mr. Justice Wills said he could not hear any more.

Mr. Hind: I cannot say that I have had justice from you.

Mr. Justice Wills: You must say that elsewhere, for I cannot allow it to be said here.

Mr. Hind was proceeding to make some further observations.

Mr. Justice Wills, however, interrupted him by saying that he should hold that the plaintiff, not having opened any claim, there must be judgment for the defendants with costs.

Muirhead v. The Direct United States Cable Company, Limited.—The defendant company on Monday appealed from the decision of Mr. Baron Huddleston declaring the company liable for the rent of the plaintiff's duplex system of telegraphing for a certain period during which, in consequence of defects in the cables, the system would not work. Having heard the arguments of the counsel for the defendants, that the cables, though slightly defective, would yet carry messages on the simplex system, the Master of the Rolls expressed himself clearly to the effect that the fault was in the company's cable and not in the duplex system, which was now as good as ever, and held that Mr. Baron Huddleston was right in his decision.

Lords Justices Cotton and Lindley concurred, and judgment was given against the appellants.

TEST OF AN EDISON-HOPKINSON DYNAMO.

DURING the entire fortnight ending on Tuesday evening last, an Edison-Hopkinson dynamo was running continuously at the works of Messrs. Mather and Platt for the purpose of severely testing its capabilities. Our readers will remember that we published an exhaustive series of tests on one of the early dynamos of this type in the REVIEW for September 15th, 1883; it will therefore be an easy matter to compare the results then obtained with those we are now enabled to present.

On the former occasion, however, the dynamo was not subjected to such severe tests with regard to continuous running, and Messrs. Mather and Platt are to be complimented upon the performance of the latest addition to their manufactures.

It is likely after this that we shall soon hear of various types of dynamo machines being put to a similar ordeal, and it will be most creditable to other makers if such prolonged experiments terminate under equally favourable conditions.

The chief improvements introduced into this new machine are, we believe, confined to details of brush-holders, switches, and bearings.

The dynamo is of the latest Edison-Hopkinson type with a short armature. The exterior dimensions are: length 56 in., breadth 36 in., and height 60 in., and the nett weight of the machine complete is 32 cwt.

The commutator is of copper with mica insulation, and has forty bars, and is provided with double brushes independently adjustable. The magnets are shunt-wound. The magnet resistance is 7·54 ohms; the armature resistance is 0·009 ohms.

The dynamo is designed for a continuous load of 250 ampères, at an E.M.F. of 55 volts, and to run at a speed of 900 revolutions per minute.

The efficiency of the machine is deduced from the following figures:—

	Watts.	H.P.
Total electrical power developed	= 16,246	= 21·78
" " loss in magnets	= 401	= 0·54
" " loss in armature	= 720	= 0·96
Power available in outer circuit when run as in test	= 15·125	= 20·28

Hence:

Electrical efficiency = 93·1 per cent.
Loss in magnets = 2·4 "
Loss in armature = 4·5 "

The following are particulars of the test to which the machine has been subjected:—

The dynamo was arranged for driving by an ordinary strap from a double cylinder engine made by Mather and Platt, and carried on slide rails to admit of the belt being tightened if required. One of Sir William Thomson's graded potential galvanometers was permanently coupled to the machine to give a continuous indication of the electromotive force between the terminals, and arrangements were made for measuring the current by means of a current galvanometer, also of Sir William Thomson's graded type.

The temperatures of the bearings were measured throughout the test by means of thermometers placed in mercury cups attached to the bearings, and a continuous record was kept of the temperature of the room.

The speed was indicated by a tachometer attached to the engine, and the revolutions of the dynamo counted from time to time with a counter.

The load was maintained constant throughout the test, as nearly as possible at 275 ampères, and 55 volts measured at the terminals. This is 10 per cent. above the normal load for which the machine is intended.

The machine was started on December 30th and run for five hours, when the temperatures were taken as follows:—

Room	17° C.	Magnets ...	33° C.
Pulley bearing ...	35° C.	Armature ...	76° C.
Commutator bearing	36° C.	Commutator	70° C.

At the end of 12 hours' run the temperatures were again taken:—

Room	20° C.	Magnets ...	33° C.
Pulley bearing ...	36° C.	Armature ...	84° C.
Commutator bearing	34° C.	Commutator	75° C.

Again at the end of 24 hours, the temperatures were:

Room	15° C.	Magnets	33° C.
Pulley bearing ...	30° C.	Armature	76° C.
Commutator bearing	29° C.	Commutator	74° C.

Showing that at the end of 12 hours the maximum temperatures had been reached in all parts of the machine. Subsequently throughout the entire run of three weeks' duration, the temperatures did not vary more than was accounted for by variations in the temperature of the room.

The speed maintained throughout the run varied from 910 revs. to 925 revs. with the full load and the armature and magnets warm.

The machine was run continuously, stopping 10 minutes daily to read the temperatures of the armature and commutator, and for Sunday, until January 6th, when it was stopped in order to take out the armature and have it examined to determine if there were any signs of charring or deterioration in the insulation of the wire; and in order carefully to examine the commutator. The examination was conducted by Mr. Blackburn, on behalf of the Edison and Swan United Company, and no change whatever was observable either in the insulation of the wires of the armature or in the commutator.

It was then decided to run the machine absolutely continuously for a fortnight without any break whatever, with the full load of 275 ampères. This test concluded on January 20th.

Throughout the whole of this continuous run for 14 days there was never the slightest sparking at the commutator, the bearings and magnets remained at a uniform temperature throughout, and the temperature of the commutator at the end of the run was 79° C., practically the same temperature as at the end of 12 hours. One set of brushes was used without change of adjustment for 12 days, and at the end was found to be worn down uniformly $\frac{1}{16}$ in.

The commutator was perfectly smooth and showed no signs of wear or grooving, and the armature had stood the run without the slightest swelling or any sign whatever of change in the insulation.

These tests were undertaken by Mather and Platt at the request of the Edison and Swan Company in order to show the durability of the Edison-Hopkinson dynamo under a long and continuous strain with a load 10 per cent. in excess of that for which the machine is sold. The conditions of the test were formulated by Mr. Albright and Mr. Blackburn on behalf of the Edison and Swan Company, and it was superintended by them and their representative, Mr. Creagh, during the entire run.

It proved conclusively that a dynamo of this type may be run continuously without any change in its working parts, or deterioration in the insulation of the copper conductors or change in their resistance, and that the wear is exclusively confined to the commutator and copper brushes, and that with regard to the former three weeks' run is not sufficient to produce any visible wear, and that the brushes last much longer than usually supposed, one set being capable of lasting a year on a machine running on an average three hours a day.

TEST OF A MATHER AND PLATT DYNAMO.

WE have been favoured with a copy of the report made, after tests, of a new dynamo machine, the joint invention of Mr. William Mather and Drs. John and Edward Hopkinson, to which we may return in a future issue.

For the present we may say that the above machine is compound wound, has very short magnets as compared with the Edison-Hopkinson dynamo, and its armature drum is wound in and out, like that of a Gramme ring. The report runs as follows :—

Report on a test of a 100*-lamp dynamo of Mather and Platt's new type, made at the Salford Ironworks on January* 14*th*, 1885, *on behalf of the Manchester and District Edison Electric Light Company.*

Dimensions.—2 ft. 10 in. long, beyond which the pulley projects 6 in. ; 2 ft. 5 in. wide ; 1 ft. 5 in. high, or 1 ft. 11 in., including the switch board on the top. Pulley, 8 in. diameter, 6 in. on face ; armature, 9 in. long, 9 in. diameter ; commutator, 5 in. long, 5¼ in. diameter, provided with double brushes.

Resistances.—Magnets (shunt coils)	41·5	ohms.
„ (series coils)	·049	„
Armature	·086	„

At 1,140 revolutions per minute, the machine developed 79 ampères, with a difference of potential of 106 volts, maintaining 115 Edison lamps, 16-C.P. (106 and 107 volts.)

With this output, the electrical efficiency of the machine is 87·75 per cent.

Reducing the number of lamps so that the output is only one-tenth of the above, the electrical efficiency is 74·6 per cent.

The lamps were arranged in groups of 30, 31, 28, and 26, with a switch to each group. Switching off these one after another quickly, the E.M.F. varied as follows :—Beginning with 98 volts it rose to 100, 103, 104, and 105, with no lamps on at all, the 105 falling quickly to 101 volts, indicating, as seemed the case, that the engine governor was not regulating perfectly.

Switching off all as above, only slowly, the E.M.F. rose 3 volts, viz., 98 to 101, showing the dynamo to be self-regulating, with a variation of 1½ per cent.

The machine in all its parts kept quite cool during the entire run, and no sparking was noticeable even when groups of lamps were being switched in and out.

After running for 25 hours continuously, the working parts were all cool, and the magnet coils only slightly warm.

The maximum safe working load is 8 units (or 8,000 watts).

Signed, T. R. WILLIAMSON.

Electrical Engineer of the Manchester and District Edison Electric Light Company, Limited.

NOTES.

The Electric Light for Theatres.—The electric light is to the front in the "Forty Thieves" pantomime this year at Nottingham. Each of the forty carries in his armour small incandescent lamps, one on the spear, one in the helmet, and one in the shield, the result being an electric fairy ballet of (with captain and officers) 129 fairy lamps. For this scene alone 376 elements are used, and require five gallons of solution to charge them. Each of the "Forty Thieves" carries a 9-cell bichromate battery, three cells being used for each of the three lamps ; the wires are mostly inside the dresses, and the connections (486 in number) with the dresses, armour, and batteries require to be made quickly and securely, as the changes from one scene to another are very rapid. There are 376 zinc and 752 carbon elements, the carbons being double in each cell. The whole battery of nine cells measures 8 in. by 2½ in. by 4 in. Some idea of the magnitude of the undertaking may be gathered from the fact that 1,640 electric contacts must be perfect before the whole of the lamps can be lighted ; and it is not to be wondered at if, amid the tumult and confusion which invariably takes place behind the scenes at a pantomime, some connection should be imperfect. The surprise is that the manager, Mr. Thos. W. Charles, should attempt so much in so short a time. The expense, no doubt, will be considerable ; but the crowded houses will repay this, as the scene is a most charming one. The firm of Oppermann Brothers is making the special lamps, and its agent in Nottingham, Mr. G. E. Smith, is superintending the work. Mr. T. Willoughby has the care of the batteries.

The Electric Lighting Experiments in the Navy.—The experiment on board the *Colossus* turret-ship, at Portsmouth, for the purpose of determining the comparative cost of lighting the ship with Captain Colomb's lamps and the electric light, on a basis representing the average requirements during the year, was begun on Thursday week. The ship is lighted by the Anglo-American Brush Company's system of electric lighting, the dynamos, of which there are three on board, being each driven by Brotherhood engines, working up to about 15 horse-power. Every part of the ship is lighted by the new illuminant, no such complete installation having been attempted in any other battle-ship in the service. In the *Colossus* the arc light, which is still in use in the *Inflexible*, has been entirely discarded, and incandescent lamps, varying from 10 to 20 candle-power, exclusively employed. Whatever the relative cost of the two systems may turn out to be—and it is believed that the trial will demonstrate the economical advantages of electric lighting—there can be no question, says the *Times*, as to the superiority of the latter in point of brilliance and comfort. In the trial of the oil lamps the cost of oil and wick was carefully observed, and in the trial of the incandescent lamps the cost of coal and oil will be taken into consideration. Labour will not be regarded as a factor in the competition, although the lighting, cleaning, and replenishing of the ordinary ship lights take up much time. But it is, no doubt, thought that if the ship's company were not employed in this way they would simply idle away their time, and that the additional labour involved represents no specific value. The trial began at 7 o'clock in the morning, and was to be continued uninterruptedly, night and day, until 7 o'clock in the morning of the 22nd inst. Steam was supplied by a boiler at 60 lbs. pressure, and was taken by the engines at 40 lbs. pressure, the revolutions being maintained as uniformly as possible at 380 per minute, which is a comparatively low rate of speed, but which is sufficient to represent an electromotive force at the terminals of the dynamos equal to 80 volts. From 7 in the morning to 6 in the evening certain spaces were lighted by means of 139 full lamps of 20 candle-power and 46 half lamps of 10 candle-power, one dynamo being employed. From 6 to 11 o'clock 191 full lamps and 97 half lamps were switched into

use, two dynamos being employed; while from 11 o'clock until 7 in the morning the number of lights was the same as at the beginning. It was found during the day that the current for each of the full lamps was equal to ·77 ampères, and for the half lamps ·46 ampères, and that the temperature in the dynamo room was 84°. On the last day of the trial, in order that the average time might be represented during which lights are used at quarters, all the lamps—police and other—throughout the ship were to be lighted, with the exception of those in the cabins, main deck aft and forward, and the store and provision rooms.

A contemporary adds:—"It will, we think, be generally agreed that the duration of the trial does not cover a sufficient space of time to be able to judge fairly of the relative qualities of the two systems, but as regards brilliancy of light, efficiency, and comfort, there is no doubt the electric light will be superior; but it remains to be seen whether these points will not have to succumb to that of cost."

Electric Lighting in Australia.—Electric lighting in Australia is spoken of by Mr. McLean, of Melbourne, as follows:—"Of the electric light there is very little to be said. Some efforts have been made, especially in Elizabeth Street, Melbourne, one of our principal streets, but it was not a success, and all efforts on a large scale have been abandoned. There are a few lights kept going in some of the theatres, but what it costs I cannot say, except that I believe that the managers will not pay more for it than they have to pay for gas, and so I presume it is kept on there as a kind of standing advertisement. The belief in the colony is the same as that in England, viz., that electricity as a light is only yet in its infancy, and with this conviction there does not seem a disposition to help the problem forward."

Lighting of the "Aquidaban."—This vessel, constructed by Messrs. Samuda Bros., of Poplar, for the Imperial Brazilian Government, and launched on Saturday, is to be fitted with the electric light, and we hear that Messrs. Crompton & Co. have been entrusted with the work.

The Electric Light in French Primary Schools.—The introduction of the electric light into the primary schools of Paris is spoken of.

Lighting the Hippodrome by Electricity.—The gas lamps in the Hippodrome in Paris are to be dispensed with, 800 Edison incandescent lamps to be used in substitution therefor.

The Brussels Electric Light Exhibition.—The Palace du Midi will probably be the *venue* of the Electric Light and Gas Exhibition to take place at Brussels this year.

Electric Lighting Progress in America.—Less than one year ago the Municipal Electric Light Company was organised, and started business with only 115 lights. The demand is such that the capital stock has been increased to $250,000, and a new station, of iron and brick, fire-proof, 60 by 100, is being erected to accommodate the increased business. The capacity of the new building will be for 600 lights. The Thomson-Houston system is used by this company. President Cooper says that one electric light, costing $250, will give more light than 12 gas lamps that cost $350 per year.

Electric Lighting in the Fulham District.—The West Middlesex Electric Lighting Company announces that it is prepared to receive proposals for the execution of the first section of its works authorised by the Fulham District Order, 1884. Plans and particulars are to be obtained from the secretary, Mr. W. G. Colley, Caxton House, The Grove, Hammersmith.

The Edison Electric Lighting Systems in the United States.—The total number of incandescent lamps in the United States at the present time in isolated plants is 75,000, and in central stations 34,800, making a total of about 110,000 lamps in all, within the United States, which would represent 14,000 H.P. The most important part of the Edison company's business is that of licensing and organisation of local companies for central stations, where the current is furnished to the consumer from a central point, and charged by a meter according to the exact quantity of light consumed, at prices not exceeding the ruling prices of gas, and leaving a profit to the sub-company. The secretary of the company says this has never been accomplished either electrically or commercially by any other system of electric lighting in the world. In the city of New York the company has 600 customers, using 13,000 lamps all lighted from one station, and has applications from 100 customers more than it is able to supply with its present capacity. That station is now earning a very handsome profit, and has been running day and night for more than two years.

The Lighting of Burntisland Harbour.—At the monthly meeting of the Burntisland Harbour Board the harbour engineer, Mr. R. Henderson, brought up a report on lighting the harbour by the electric light, with motive power furnished by a Crossley gas engine. The report was favourably considered, and was handed over to a committee.

The Electric Light at an Ice Carnival.—The *Pall Mall Gazette* in its account of the great ice carnival, which begins in Montreal on the 26th inst., notifies a grand open air masked ball on skates on the M'Gill College Grounds, with the electric light for brightness and the starlit sky for a roof or canopy.

Electric Light at a Ball.—A very rapid installation of the electric light was completed last week by Messrs. Woodhouse and Rawson in the lighting of the batchelors' ball, which took place at the Crown Hotel, East Grinstead. The interiors of the rooms were lighted by incandescent lamps, and the exterior of the building, and the High Street, by arc lights, which burnt with remarkable brilliancy and steadiness, illuminating the street on either side for a considerable distance, the effect being greatly enhanced from the fact that the ground was covered with snow. The installation consisted of two Marshall's engines of 7 H.P., two Bürgin machines, 100 Woodhouse and Rawson incandescent lamps, and two Crompton arc lamps of 3,000 C.P. The whole of the wiring in the house was completed with sufficient care for a permanent installation, the joints all being carefully made and properly insulated. The electroliers were all made specially for the purpose, and were completely covered with evergreens, eight being used in the ball room with four lights each, and four in the supper room with eight lights in each, the others being distributed in a similar way in the sitting rooms, hall, and passages. The whole of the work was completed in three days, the dynamos only arriving late the night before the ball. In addition to this a shed, 25 feet by 40 feet, had to be constructed for covering over the engines and dynamos. The installation was started for the first time at 4 o'clock in the afternoon of the day of the ball, which was kept up until 4.30 the next morning, the light continuing without a break or a stoppage of any sort, giving great satisfaction to all present.

The Electric Light in Docks.—The Cessnock Docks at Govan, which are just now in the course of construction, were on Monday fitted up successfully with the electric light. The illumination, which will be a permanency till the works are completed, consists of five Crompton lamps of 2,000 candle-power, which give a very brilliant and satisfactory light. Owing to the introduction of the electric light, the work of the new graving-dock and the entrance quay to the Cessnock Docks will now be proceeded with by night as well as by day.

Proposed Electric Lighting Experiment in Bristol.—The Bristol Sanitary authority has issued to the inhabitants a circular asking for answers to certain questions so as to be able to arrive at a determination upon the question of providing electricity for lighting purposes throughout the city, which reads as follows:—"The Bristol Urban Sanitary authority having obtained Parliamentary powers enabling them to supply electricity within the city and county of Bristol, have in contemplation to commence operations by supplying, in the first instance, certain parts of the centre of the city; but the committee to whom the consideration of the matter is at present entrusted, before recommending the Authority to commit themselves to the great expense of providing the necessary works and appliances, are desirous of ascertaining approximately to what extent the inhabitants will be prepared to avail themselves of the electric lighting of their premises, if the same should be provided. It appears to the committee that, provided the use of a sufficient number of lamps for the lighting of houses, shops, warehouses, and places of business can be assured, the Authority may be able to supply the electricity at a price at the rate of about ½d. for each incandescent lamp of 20-candle power per hour; and the committee would be obliged by your informing them whether or not you would take the light, and, if so, how many lamps of 20-candle power, or lamps consuming multiples of 20-candle power, you would be prepared to pay for. The committee feel that it is needless to point out the great advantages of the electric light in the shape of brilliancy, absence of heat, freedom from products of combustion, which are injurious to health, and to goods, furniture, &c.; and they earnestly request you to give the subject your serious consideration, and to furnish them within a fortnight with replies to the annexed questions—it being understood that the information is sought for by the Authority for the purpose of guiding them in determining what course to adopt, and not as pledging you to anything. Mr. Benjamin Kitt, the lighting inspector of the Sanitary Authority, will be happy to furnish you with any information required." Attached to the circular are these questions, answers to which are to be returned to the Authority:—"1. If the Sanitary Authority supply electricity for lighting purposes at or about the rate of ½d. per 20-candle lamp per hour, would you take the electricity? 2. If yes, how many 20-candle lamps would you be prepared to take?"

The Electric Lighting of Dwelling Houses at Antwerp.—A number of dwelling houses in Antwerp will shortly be lit by electricity. A company is now engaged in putting down plant at a central station for supplying 6,000 incandescent lamps. The dynamos are of the Gülcher pattern, the current being conveyed in underground cables on the Callender system.

Large Incandescent Lamps in America.—Says a transatlantic contemporary:—"The New England Weston Electric Light Company is now putting in the new large incandescent lamps of 125 candle-power along the line of available circuits at Boston. The light is very steady, pleasant to the eye, and is free from the disadvantages of the arc system, especially for interior illumination. Small lights of 16 candle-power can be run from the same circuit."

Electric Lighting in the Far West.—At the annual fair held at San Francisco, the Brush and the Thomson-Houston Companies on alternate nights lit the pavilion *free*. The Sperry Company had also a fine display of incandescent and other lights, for which it received the silver medal, and the other companies gold medals—not on account of superior lights, but because of their liberality. The Thomson-Houston Company lights the cities of Oakland, San Jose and Sacramento, and is negotiating for Portland, Oregon, and Los Angeles, while the Brush system seems to have a monopoly of San Francisco.

Electric Lighting at Washington.—The United States Electric Light Company has completed its underground wires for lighting F Street, Washington, from 9th to 14th Street, and has supplied the light for the past two or three weeks. The laying of the wires was quite expensive, as the concrete pavement had to be cut up, but the business men on the street generously contributed a sufficient sum to make up the difference, and the street is now beautifully illuminated. The lamps are placed on posts about 10 feet high at short intervals along the curb, the wires, running up inside from beneath the ground, not being visible. A further extension of this mode of street lighting is contemplated by this company. It already has a number of subscription lamps in front of business places on Pennsylvania Avenue, which in some localities make this broad avenue quite brilliant.

Competition between American Electric Lighting Companies.—The close competition between the rival electric lighting companies in New York, says the *Electrician and Electrical Engineer* of that city, is aptly illustrated by the proposals received for establishing an electric light plant on Ward's Island. The Board of Estimate and Apportionment granted $15,000 for the purpose. The Edison Company's bid was $13,500; the Sawyer-Man Company's $14,078, less $500 if certain fuel be supplied for 30 days; and the Brush-Swan Company's $13,735. The successful bidder will be compelled to furnish two bonds of $10,000 each, and guarantee the working of the plant for six months. According to the specifications 876 burners will be used on the island.

The Bell Patents in Canada.—Says the *Electrical Review* of New York:—"Until the Minister of Agriculture at Ottawa, Canada, has gone through the evidence taken in the suit to set aside the Bell telephone patent in Canada he refuses to give his decision. The question raised is an important one, and should it be decided against the Bell Company there are hundreds of valuable inventions patented in Canada which will probably suffer the same fate. The Bell Company admit that unintentionally they have not acted up to the full letter of the law, but they think that a liberal interpretation should be placed upon it in view of the large interests at stake."

Telephone Exchange at Inverness.—On Monday the telephone exchange in Inverness of the National Telephone Company was opened. The exchange is situated in Union Street, and connections have been established with the principal places of business in town and suburbs. Connections are to be made with neighbouring towns, such as Nairn and Dingwall.

The Telephone in the Lancashire District.—The Lancashire and Cheshire Telephonic Exchange Company announces the opening of call offices in various parts of Manchester, Liverpool, Blackburn, Preston, and other towns in Lancashire and Cheshire. Payment will be at the rate of 3d. for a conversation of three minutes or fraction thereof, or 6d. for the same period if the person spoken to is resident in another town and the trunk-wire has to be used. The company's exchanges will shortly be connected with the chief post offices, so that subscribers may receive and send telegrams direct. A charge of 10s. per mile per annum will be made to subscribers for connection with the trunk-wire. Special rates are offered to the press between the hours of 8 p.m. and 8 a.m. The following is a list of the towns in Lancashire and Cheshire which are now connected:—Accrington, Ashton-under-Lyne, Blackburn, Bolton, Burnley, Bury, Chorley, Darwen, Heywood, Liverpool, Manchester, Middleton, Oldham, Preston, Radcliffe, Rochdale, St. Helens, Stockport, Warrington, Widnes and Runcorn, and Wigan. Other towns in Lancashire, Cheshire, and Yorkshire will shortly be connected with those named above.

The United Telephone Company v. Reid.—An order was taken in default of appearance by the defendant in this case, which was to have come before Mr. Justice Pearson on Saturday, the 17th inst., to restrain the infringement of the plaintiffs' patents.

The Telephone Cases in America.—The correspondent of the American *Electrician and Electrical Engineer*, at Boston, writes to that journal:—"It is the world's news now, that the Drawbaugh claimant has gone to join the long line of which the Tichborne claimant is a shining example. The news of Judge Wallace's decision was first received at the American Bell Telephone office, in this city, and over their telephone line from New York—the brokers getting their information later by private wires. The stock of the company sold in the morning stock board at 220 and 215—but, after the brokers had picked the lambs clean, the stock shot up to 275—and holders expected to realise at 300, but the public did not come in with that tumultuous rush of former years, so there was a sag. The announcement by the company of a special dividend of 3 per cent. for holders to put in their Christmas stocking, sent it up again, but the first wave was the highest. The result was of course very gratifying to those who were fortunate holders of the stock; there were many, however, who *intended* to participate, but had not nerve enough to jump in. The Overland Telephone case, suspended last January in Philadelphia, will now be the next thing to settle; the judges in that case holding off, it will be remembered, to hear the decision in the case now decided, as the Drawbaugh evidence was introduced by the Overland people. Of course the Overland case was practically decided when Judge Wallace sat down so hard on Dan. With the Drawbaugh and Overland companies enjoined, the telephone field will be comparatively clear; whether the Baltimore and Ohio telegraph people, who are sponsors for the Meucci first-inventor-claimant will make a stand remains to be seen. The recent decision would seem to be a wet blanket to claimants whatever their pretensions; and the Meucci-man, who evidently thought he could speak numberless miles through a hollow tube, using a battery and key for signalling, will not use up the 'monopoly' very thoroughly."

Long Distance Telephoning.—An American contemporary says that the statement comes from a director of the Bell Company that among the enterprises to be pushed by the company is long-distance talking, and that soon New York and Philadelphia, and eventually New York and Chicago, will be connected, using the hard-drawn copper wire, such as now connects New York and Boston. Connections are to be made with subscribers by means of private switchboards without the intervention of the central office.

The Telephone in France.—Telegraphic communication between Rouen and Havre was opened on Saturday last; the charge being a franc for every five minutes. The two telephones are at the post and telegraph head offices; but the branch offices will eventually be accommodated, as also the telephone network in both towns.

Extension of the Mackay-Bennett System.—The Bankers and Merchants' Telegraph Company is to run four additional wires from New York, passing through Hartford, in connection with the Mackay-Bennett cable system.

The Commercial Cable Company.—The Commercial Cable Company has completed the laying of its subterranean connection with the office at 21, Wall Street by drawing a cable through an iron pipe laid under the pavement from the East River Bridge, *via* Water and Wall Streets. Cable telegraphy is a novelty in New York, and the syphon recorder has been placed where it is easily viewed from the sidewalk through the plate-glass front.

The Fastnet Cable.—The laying of the cable connecting Lloyd's signal station on the Fastnet Rock with the mainland has been successfully accomplished, and, according to a telegram dated January 15th, all that remained to be done was to connect the cable with a loop land wire to the postal telegraph office at Crookhaven.

A Proposed New Cable.—In view of the desirability of providing a means of communication by telegraph between this country and the British Settlements and Protectorates on the West Coast of Africa, Her Majesty's Government is prepared to recommend Parliament to grant a subsidy on certain conditions to a contractor who will undertake to lay, maintain, and work a submarine telegraph cable from St. Vincent (Cape Verde Islands) to Bathurst, Sierra Leone, Accra, and thence to a place along the coast not further east than Victoria Settlement, in Ambas Bay, either (a) direct, or (b) touching *en route* at Lagos, or (c) touching *en route* both at Lagos and a place on the Niger, to be hereafter determined.

Telegraph Revenue.—The receipts from April 1st, 1884, to January 17th, 1885, amounted to £1,420,000, the same total as was reached on January 19th last year.

Secondary Batteries.—The following letter from Mr. F. Geere Howard appeared in *Engineering* last week; the letters from Mr. Sellon and Messrs. Elwell and Parker, published simultaneously with it, were given in our correspondence columns last week. "Mr. Sellon in your last issue makes use of the following somewhat remarkable expression: 'It is not only contrary to fact, but to *common sense*, to suppose that their (Elwell-Parker) form, in which no packing of active material is used, can be either charged or discharged as rapidly as my plates.' I should like to point out to Mr. Sellon that he is entirely in error upon this point, and if he had experimented *personally* with both forms he would have found out long ago that his form of plate will not discharge at the same rate as the 'Planté' type, in spite of that 'unknown quantity' common sense. That his form of cell will receive a greater rate of charge I admit, and it is because it has a greater thickness of working material; but the rate of discharge does not depend upon the same conditions, and hence the difference between the two forms of cells and the purposes for which they are suitable. I was not aware, as Mr. Sellon surmises, that the Electrical Power Storage Company had a special construction of cell in hand for use as a regulator, but should doubt its being cheaper than thin cast lead plates; possibly it might be less bulky; but of this I can say nothing, not having had the advantage of seeing it. At any rate it would be interesting to know whether the company employs in this new form their system of packing in active material or plain lead only; if the former method be still used, the cost I should think cannot be less; but if the latter be adopted, how will it reconcile Mr. Sellon's remarks about the higher discharge of his plates, as I take it that a battery to act as an efficient regulator requires, practically speaking, no storage capacity, but very high discharging qualities. The suggestion of both manufacturers to have their cells tested by an independent authority is a good one, and the results thus obtained would be very interesting indeed to electricians, but I am afraid will not take place, as the experiments, to be of any use, should be extended over some months at least."

The Pabst Primary Battery.—A correspondent requests the following information relating to the above battery which was spoken of last week in our "Notes." 1. What is the containing vessel? 2. What size are the elements? 3. In what proportion is the ferric chloride mixed? 4. Is there any data as to how long it would work without recharging? 5. What amount of current in ampères would a given size cell produce?

Incandescence Lamps at the Vienna Exhibition.—The incandescence lamps, for the exhibition of which, amongst other electrical appliances, Messrs. Woodhouse and Rawson received a gold medal at the Health Exhibition, have lately received much attention; and the small current taken by them has been frequently commented upon. Below will be found a summary of the results of the tests upon these lamps by the jurors, Prof. Dr. Erasmus Kittler, Prof. Dr. Antonio dos Santos Viegas, Dr. Josef Hauberer, and Dr. E. Maiss, of the Vienna Exhibition. These will be of interest, as they bear out the high efficiency claimed for these lamps. In the first tabulated statement it will be seen that the lamps, even when run far below their normal candle power, have an exceedingly high efficiency. For instance, it will be seen that whereas a 20-C.P. lamp has an efficiency of about 2½ watts, when it is running at about 12-C.P. it has an efficiency of 3·13 watts per C.P., about equal to the Swan lamp; and when running at about 8 or 9 C.P. an efficiency of 3·77 watts per C.P., about equal to the Edison lamps. Of course, when the lamps are underrun in this way, the length of life should be very considerable. The second statement gives the average efficiency of the total number of lamps tested, namely, 2·38 watts per candle-power, or 312 candles per H.P.

Normal C.P.	Observed C.P.	Current in amperes.	Difference of Potential in volts.	Resistance hot in ohms.	Watts absorbed.	Watts per C.P.	No. of candle per electric H.P.
20	4·64	0·779	35·24	45·26	27·44	5·91	122
	6·85	0·838	37·65	44·95	31·54	4·60	160
	8·98	0·869	38·92	44·80	33·81	3·77	196
	10·85	0·905	40·35	44·59	36·51	3·37	219
	12·18	0·926	41·21	44·52	38·14	3·13	235
	15·58	0·966	42·83	44·32	41·38	2·66	277
	20·32	1·018	44·88	44·10	45·67	2·25	327
	26·27	1·071	46·92	43·79	50·27	1·91	385
	34·24	1·126	48·93	43·44	55·11	1·61	456
	45·18	1·193	51·25	42·95	61·16	1·34	551
Average of total number of lamps tested.							
	20·78	1·072	46·26	43·71	49·38	2·38	312

These tests agree very well, we understand, with the Wimbledon tests made by Mr. Preece upon the Woodhouse and Rawson lamps, which, however, were lamps of a little later make. Messrs. Woodhouse and Rawson tell us that the lamps for the Vienna Exhibition were made over a year ago, and at the present time the lamps are much better, there having been a steady improvement since.

Telegraph Lineman Killed.—A man named Duncan Junnor, in the employment of the Caledonian Railway Company, was on Tuesday accidentally killed while engaged at work on the line near Sighthill Station. At the time of the occurrence the deceased was in the act of repairing the telegraph wires, and while proceeding along the side of the line with a pole on his shoulder for the purpose of doing some work at the east junction, he was run over by an engine and instantaneously deprived of life. It is stated that he happened to step upon the line when the engine was being run into one of the sheds. The body of the unfortunate man was afterwards removed to the mortuary at St. Rollox Police Station. Deceased was about 30 years of age, and resided at St. James Street, South Side.

Irregularities by an Electric Lighting Company's Secretary.—At Clerkenwell Police Court on Saturday last week, Alfred Jermyn, 40, living in Selhurst Road, South Norwood, was charged with having feloniously appropriated a sum of £10, the moneys of the South Eastern Electric Light and Power Company, by falsifying accounts. The prosecution was conducted by Messrs. Powell and Burt, solicitors to the company, and the opening statement showed that the prisoner had been secretary to the company, the offices of which are at Cow Cross Street, West Smithfield, from the institution of the company. At the close of last year, from matters that had come to the directors' knowledge, the prisoner's engagement was terminated. On the 9th of January the manager, Mr. Offor, received a letter which was in the prisoner's handwriting, saying that from anguish of mind he was compelled to confess that there were irregularities in his accounts which had commenced in July last. He had, he said, on receiving a sum of £50 for expenses at Colchester and other places taken a large portion of it and lost it. He had then, to make up the deficiency, paid into the company's bank a cheque for £10, paid by a Mr. Hislop on account of "calls," and made that and other sums appear as part of the account. The directors having decided to prosecute in the case, the prisoner surrendered himself to the police. Evidence having been taken bearing out the opening statement, Mr. Barstow committed the prisoner for trial, and the witnesses were bound over to prosecute.

The Exchange Telegraph Company and the Stock Exchange.—For some time the question whether or not the Exchange Telegraph Company should be allowed to continue its office in the Stock Exchange, and to furnish prices by means of the "tape" to its subscribers, has been under the consideration of the managers of the Stock Exchange, and we now learn that the company has received the following communication:—"Stock Exchange, London, January 20th,—Since the interview between your directors and my board on Friday last the following resolution has been confirmed:—Resolved, 'That in the opinion of this meeting it is undesirable to continue the connection of the Exchange Telegraph Company with the Stock Exchange.'" A formal notice accompanied the letter, in which the company was directed within three months to remove its wires and repair any damage that might be done in the operation. The decision of the committee has not met with universal approval among the members of the Stock Exchange; but the *Times* thinks that the mere fact that the prices shown on the tape will now be despatched from the outside of the building instead of the inside will not make any difference.

NEW COMPANIES REGISTERED.

Varley Electric Patents Proprietory, Limited.—Capital, £40,000 in £5 shares. Objects: To purchase certain letters patent granted to F. H. Varley and others, for inventions relating to electric carbons, generators and storers, meters, lamps and appliances, dynamo machines, apparatus for opening and closing electric currents, and for improvements in packing, also applicable for fitters and extractors. The purchase consideration is 2,450 fully paid shares, and £4,560 in debentures. Signatories (with 1 share each): *F. H. Varley (electrical engineer), 82, Newington Green Road; *R. H. Padbury, 34, Mildmay Grove, N.; J. R. Shearer and Mrs. J. R. Shearer, Queen Elizabeth's Walk, Stoke Newington; G. Putman, 56, Mildmay Street, N.; E. Schultz (electrical engineer), Charlton; *J. T. Carrington, York Chambers, Adelphi. Directing qualification, 20 ordinary shares. The shareholders in general meeting will determine remuneration. Registered 15th inst. by Nash and Field, 12, Queen Street, E.C.

Foreign Pilsen Electric Light and Power Company, Limited.—Capital £30,000 in £1 shares. Objects: To purchase the business, property and assets of the Union Electric Light and Power Company, Limited (in liquidation). Signatories (with 1 share each): *A. Parrish, 2, Copthall Buildings; *James Fyfe (electrician), St. Stephen's Chambers, Telegraph Street; *J. W. Goddard, jun., 81, Gracechurch Street; E. J. Paine,

47, Gresham House; H. M. Scriven, 34, Great St. Helen's; J. Richardson, 3, Lombard Court; *D. Parrish, 2, Copthall Buildings. Directing qualification: shares or stock of the nominal value of £1,000; remuneration, £600 per annum. Registered 20th inst. by Walter Webb & Co., 23, Queen Victoria Street.

* Signatories whose names are preceded by an asterisk are also directors.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Telephone Company of Austria.—The annual return of this company, made up to the 12th inst., was filed on the 17th inst. The nominal capital is £100,000 in £5 shares. The number of shares taken is 8,157, of which 8,000 have been issued as fully paid. Upon the remaining 157 shares the full amount has been called up, the calls paid amounting to £750, leaving £35 unpaid. Since the registration of the previous return 2,150 shares have been allotted. Registered office, 34, Walbrook.

Australian and New Zealand Electric Company, Limited.—At extraordinary general meetings of this company, held at the offices, No. 15, Austin Friars, on the 22nd ult. and 13th inst., it was resolved to wind up voluntarily. Mr. Lewis Abraham Tallerman, of 1 and 2, Chiswell Street, E.C., was appointed liquidator. This resolution was duly registered on the 17th inst.

CITY NOTES, REPORTS, MEETINGS, &c.

Western and Brazilian Telegraph Company, Limited.

THE twelfth ordinary general meeting of this company was held at the Cannon Street Hotel on Thursday, Sir Henry Drummond Wolff, G.C.M.G., K.C.B., M.P., presiding. The attendance of shareholders was not large. The report of the directors was published in our last issue.

Mr. Cunningham, the secretary, having read the notice convening the meeting, and the minutes of the previous meeting having been confirmed,

The Chairman said: You will have seen by the report and accounts that the revenue this year unfortunately shows a diminution of £6,300. This is principally owing to the interruption which took place in the Brazilian Submarine Company's line, by which we lost between £20,000 and £25,000. Notwithstanding that, owing to the new arrangements made, I am happy to say the net loss was nothing of that kind. Fortunately the Brazilian Submarine Company with great spirit and energy proceeded not only to re-lay the line broken, but have duplicated it; therefore I hope hereafter we shall have no interruption in the principal feeder of our line. It may be interesting to the shareholders to know that the reduced tariff at which we are now working has answered remarkably well. In 1882 we carried 42,987 messages of 375,766 words; in 1883, 48,259 messages of 401,782 words; and in 1884, 101,692 messages of 969,814 words; the traffic therefore having more than doubled itself. In the year 1883, the company carried 57 per cent. of the international traffic and the Government 43 per cent.; while in the year to September, 1884, the company carried 90 per cent. of this traffic and the Government only 10 per cent. In the first quarter of this year we have to a great extent recouped ourselves for the loss which unfortunately took place last year, because we have £15,000 in the first sixteen weeks, against £21,000 last year. Of course the amount was smaller last year, owing, to a great extent, to the breakage; but compared with the year before, when there was no breakage, our traffic shows an increase on the first sixteen weeks of £5,746, notwithstanding that we have reduced our tariff so considerably. On the question of traffic and receipts, the company has good cause to congratulate itself. Against this excess in receipts there has been no proportionate increase in the expenses of the year—it has been very slight. Unfortunately we still have to spend a great deal of money on maintenance, and the ships, no doubt, cost us a great deal of money, but, on the other hand, the presence of the ships there has greatly aided us in the repairs we have had to make; and we have not only made very great repairs, but have entirely relaid a great portion of our line—to the extent of 382 miles. This has reduced our unrenewed cable to only 450 miles out of our whole system of 2,500 miles, and this unrenewed cable—what is called the grid-iron cable, laid in deep water—we thought for a long time was safe in deep water, so long as it did not come near land; but, unfortunately, such is not the case, and we have found it absolutely necessary for the safety of our system to relay the whole. Our system now consists of 2,050 miles of sheathed cable, and 450 miles of the old type. It is our duty and policy to go on gradually relaying, until we have nothing but sheathed cable. I don't want to go into past history, but, at the same time, shareholders know very well that the present board is not responsible for the inferior type of cable. The attention of the board has been very much turned to the question of expense in regard to the ships. Those ships have been indispensable, and have been very useful to us in enabling us to at once send the necessary appliances of the repairing of breakages, as well as for the laying of new cable. It will also interest shareholders to know that in the laying of the new cable we are anticipating to have very little repairs. Now I wish to say one word on a subject which is not particularly agreeable, which is the dividend. [A Shareholder: Non-dividend!] Well, non-dividend, if you like that better. But of course the shareholders must see that nothing can be more agreeable to directors than to be able to declare a dividend; in fact the objects and interests of the shareholders and directors are identical. [A Shareholder: They ought to be, certainly.] And I hope they are: but at the same time we directors, knowing the state of the company, the state of the finances and of the cable, have a great responsibility to discharge, and I do not think we should be right in shrinking from it, and, therefore, I unhesitatingly say that for the interests and prosperity of the company, it is better not to pay a dividend this year. The shareholders must be aware that we are studying constantly throughout the year the state of our property, and that we have reasons for arriving at the decision to which we have come. There are a great many differences of opinion as to what is called the life of the cables, and I won't go into that now; but, at the same time, with the views and opinions with which we have been fortified by experts and legal men, we think it absolutely necessary that our renewal fund should not be below a certain sum, and as this year we have had to diminish our renewal fund to a considerable extent by reason of repairs—by the sum of £36,000—we think it absolutely necessary to replenish our renewal fund with £15,000, which might have been applied to a dividend had we considered it right to do so. The £15,000 is not paid to the shareholders, but nevertheless it is theirs; it goes to the renewal fund for the maintenance of their property, and having regard to this, I can only say that in my opinion the company has a very prosperous look-out. With regard to the negociations between the Government and ourselves, I think the policy we adopted in reducing our tariff has been successful, and I know that the attention of the Brazilian Government has been turned to the necessity of some understanding with us. I think this year we are likely to receive in England a visit from certain Brazilian officials, who will be empowered to come to some arrangement with us, but until then the least said the better. I beg to move the adoption of the report and accounts for the year ending 30th September, 1884.

Mr. Andrews seconded.

Mr Herring said he had been unable to discover in the report any valid reason for the intention of the directors not to recommend a dividend. He saw that from beginning to end the darkest side of the position was shown in that report, and not the *couleur de rose* side. He had the highest respect for the directors individually and collectively, and had no intention of saying one word against their management. The report stated that the expenses included the sum of £1,129 for depreciation of the ss. *Viking*, an item which did not enter into last year's accounts; but in the report for the last year he saw included the sum of £1,800 for depreciation of the *Norseman*, which, he contended, amounted to the same thing. Having further criticised the wording of the report, Mr. Herring said a sum of money was placed in what was called, not the reserve fund, but the renewal fund, and that fund, he took it, was only meant for the renewal of the cable—that was, to replace the old strand type of cable with sheathed cable. There was no question of its going to the reserve fund. For that purpose £36,000 had been expended during the past year, and according to the report only 450 miles remained to be relaid, which would take about £45,000 to finish. He wanted to know upon what possible pretext the £15,000 had been added to the renewal fund, which already stood at £131,000. He moved, as an amendment "That this meeting do not adopt the report, and request the directors to re-consider the question of the payment of a dividend."

Mr. Dyer seconded the amendment.

Mr. Chappell said that after waiting twelve months before having any communication from the directors, it was a great disappointment to be told that there was to be no dividend. He gathered from the report and from the chairman's remarks that the blame was with the Brazilian Submarine Company; but he threw it all upon the directors themselves. They were certainly £6,000 or £7,000 poorer through the breakages in the Submarine Company's cables, but there was £18,000 carried over, and instead of that being appropriated to the renewal fund, he thought the shareholders should be paid a dividend of 2½ per cent. on the deferred shares. When they remembered that £140,000 was carried over last year as renewal fund, it was exceedingly unjust that this sum of £15,000 should be taken from them.

Mr. Sutton thought the amendment imputed to the directors almost ignorance of their duties, and it was quite useless to ask them to reconsider their decision. He suggested that the amendment should be "That a dividend be declared." He saw no reason why they should not have a dividend for the past year.

A Shareholder protested against the directors sending out proxies for their own benefit at the expense of the shareholders. He suggested that if they were sent at all they should be unstamped.

Major Cotton said the directors were their representatives, and

as large shareholders themselves would have been very glad to recommend a dividend. But if a dividend were declared, and it was afterwards ascertained that it was not fairly earned, they were answerable for that dividend. They did not see their way to declare a dividend, and he thought it would be a mistake to force the matter to a division.

Mr. Baker said last year there was a balance to the revenue account of £29,000, and, whether rightly or wrongly, £26,000 of that was paid as dividend without anything being added to the renewal fund. This year there was a much smaller balance, and nearly the whole of it was applied to the renewal fund. Either the directors were very wrong in declaring a dividend last year or this year they had very much overstrained the point by not paying a dividend. In the course of his remarks, Mr. Baker said that within the last three months he had seen the name of Sir Henry Drummond-Wolff posted up in the Stock Exchange as the purchaser of about a thousand of the deferred shares of the company. There was nothing in the report as to the negociations with the Brazilian Government, and all the shareholders knew about it was from rumours and suspicious movements in the market. With respect to the legality of the position of the shareholders in moving the payment of a dividend, which had been questioned, he would state emphatically, the opinion of the solicitor notwithstanding, that the board had the right to recommend a dividend only, and the shareholders had the power to say yea or nay to it. He moved that a dividend be declared of 2½ per cent.

Upon the suggestion of Mr. Robinson Kendal, the other amendments were withdrawn in favour of that of Mr. Baker.

A Shareholder asked whether the directors speculated in the shares of the company. If they did use their superior knowledge to buy and sell in the company it was unfair to the shareholders and to those who speculated from outside.

The Chairman said, with regard to the transaction Mr. Baker had attributed to him, he would say that he never bought or sold in the company. A friend of his, who knew little of business matters, asked him to have 500 deferred shares bought for him, and he (the Chairman) instructed his broker to buy, but not to use his name. The broker was out of town, and his (Sir Henry's) name was used. As soon as he heard of it he had it altered. Answering the various points raised in the discussion, he said, with respect to the *Viking*, they had only recently purchased that ship, and, therefore, the depreciation on the vessel was a new expense. Mr. Herring had said that money for the renewal of the cables should be taken irrespective of the dividend. In answer to that he would say that they were advised that the renewal fund was only just sufficient, even if the whole of the cable were sheathed. They had 3,000 miles of cable which they were bound to renew at some time or other, and even if the whole were sheathed the renewal fund they kept was barely sufficient. They had taken the example of other companies, the advice of experts, and of some of the greatest lawyers of the day, and they must keep up a renewal fund such as was necessary in respect to the length and quality of the line. With regard to the motion for a dividend, he thought they would find in the Joint Stock Companies' Act a provision that the articles of association of a company are to be accepted as binding in the management of the company; and as the articles of association said that the shareholders should not have the power of declaring a dividend larger than met with the approval of the directors, he was obliged to rule that the motion for a dividend was out of order.

Major Wood, a director, said when they declared a dividend last year they did not know they would have to spend so much money for the repair of the deep sea cable; they had every reason to believe that the old strand cable—a legacy from others, which ought never to have been laid—would be easily lifted when it broke, or that it would last much longer through being in deep water. Unfortunately those expectations had not been realised, and the cable was getting worse and worse from year to year. There were many present who were aware of the circumstances under which they got the money for the renewal fund; as a matter of fact it was returned capital, and it was ear-marked as returned capital. They must preserve that renewal fund at a certain figure. It was not a question of 450 miles of cable only; they had altogether 3,780 miles of cable which was getting on in years, some of it 12 years old, and they did not know how long it would be before they would have to repair some of it.

Mr. Andrews, another director, having spoken,

The Chairman declined to accept Mr. Baker's amendment, whereupon Mr. Baker went through the form of putting it himself to the meeting, declaring it carried.

The Chairman then put the original motion for the adoption of the report, and amidst vociferous shouting stated that it was carried.

The retiring directors, Messrs. Earle and Weaver, and the auditor, Mr. Weise, were re-elected; after which the meeting terminated.

The Cuba Submarine Telegraph Company, Limited.

THE directors beg to submit, duly audited, the balance sheet and accounts for the half year ended 31st December last.

From these it will be seen that the gross receipts, including the balance brought from last account, amount to £15,710 8s. 10d., and the gross expenditure, including the half of the annual payment on account of the 1881 cable, to £6,119 15s. 4d., leaving a sum of £9,590 13s. 6d. to the credit of revenue account.

Of this the sum of £550 has been added to the reserve fund, increasing that fund to £60,000.

The dividend on the preference shares will absorb £3,000, and leave £6,040 13s. 6d., out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 7 per cent. per annum, free of income tax, the balance, £440 13s. 6d., being carried forward to the current half year's account.

The directors have much pleasure in reporting that all the cables have continued in good working order with the exception of one of the harbour lengths at Cienfuegos, which has become worn out. A new spare length, it will be remembered, was laid in the beginning of last year.

A piece of ground has been purchased at Cienfuegos, upon which a store has been built to contain the machinery for the repair of picked-up cable. Tanks have also been fitted up therin for the reception of spare cable.

The tax to be returned by the Spanish Government, referred to in last report, has not yet been received.

Eastern Telegraph Company, Limited.—The 25th half-yearly report of the directors shows a revenue of £309,570 and a disposable balance of £191,640. Two interim dividends of 1½ per cent. each and a bonus of another ½ per cent. have been paid on the ordinary shares, after provision had been made for the interest on the debentures, debenture stock, and preference shares. A balance of £30,364 is carried forward. Including interest received, the general reserve fund at the end of the half-year stood at £319,761.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 2nd were £2,480, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th January, are £2,763, as compared with £2,571 in the corresponding period of 1884.

NEW PATENTS—1885.

521. "Electrical contact makers or circuit closers." Hon. R. T. D. BROUGHAM, J. K. D. MACKENZIE. Dated January 14.

562. "Improvements in connection with telegraph signal and like poles or standards for steadying and retaining them in position." W. B. INCLEDON. Dated January 15.

593. "Electric contact apparatus." G. BINSWANGER. Dated January 15.

597. "Appliances for connecting telegraph cables between ships and the shore or themselves." R. ATKIN. Dated January 15.

612. "Dynamo-electric machines." F. PRESTON. Dated January 16.

630. "Tempering steel or other wire by the application of electricity." A. THOMPSON, R. O. RITCHIE. Dated January 16.

639. "Arc electric lamps." R. P. SELLON. Dated January 16. (*Complete.*)

652. "Telephone Transmitters." T. J. HANDFORD. (Communicated by E. H. Johnson.) Dated January 16.

654. "Economic production of electric light for domestic uses." B. J. B. MILLS. (Communicated by C. J. M. Barbier.) Dated January 16.

699. "Electric batteries." C. W. STEWART, R. OAKLEY. Dated January 17.

749. "Method of constructing, operating, controlling and regulating electrical machines or the electrical circuits thereof for the development or utilisation of electric force and apparatus or means employed therefor or therewith." J. S. WILLIAMS. Dated January 19.

750. "Method of constructing, operating, controlling and regulating electrical machines or the electrical circuits thereof for the development or utilisation of electric force and apparatus or means employed therefor or therewith." J. S. WILLIAMS. Dated January 19.

751. "Elements of apparatus for the development or utilisation of electric force and the method or means employed in the construction thereof." J. S. WILLIAMS. Dated January 19.

752. "Elements of apparatus for the development or utilisation of electric force and the method or means employed in the construction thereof." J. S. WILLIAMS. Dated January 19.

753. "Methods of or means for obtaining definite conditions in electrical apparatus and in the operation and construction thereof and the methods or means employed therefor or therewith." J. S. WILLIAMS. Dated January 19.

763. "Apparatus for measuring electromotive force and electrical currents." R. THRELFALL. Dated January 19.

786. "Generation and distribution of electricity and means or apparatus employed therein." A. J. BROOKES. (Communicated by O. Gassett.) Dated January 20. (*Complete.*)

798. "Method of and apparatus for manufacturing compound telegraph wire." H. J. ALLISON. (Communicated by M. G. Farmer.) Dated January 20. (*Complete.*)

800. "Treating sulphides in alkaline solutions by electrolysis." H. W. DEACON, F. HURTER, W. ELMORE. Dated January 20.

804. "Telephone receivers." H. P. PRATT. Dated January 20. (*Complete.*)

812. "Apparatus employed in the telegraphic intercourse between trains and stations." B. J. B. MILLS. (Communicated by C. Diener and C. O. Mayrhofer.) Dated January 20.

819. "Mode of making and breaking electric circuits." V. WILLIS. Dated January 20.

829. "Electric lighting of railway trains and for other analogous purposes." W. MATHER, J. and E. HOPKINSON. Dated January 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

1548. "Improvements in globes for incandescent electric lamps." J. G. LORRAIN. Dated January 16. 2d. The inventor employs a bulb or globe, part of which is composed of clear or transparent glass, and part of a kind of glass which may conveniently be described as "metallic-glass." This "metallic-glass" consists of clear or translucent glass with opaque, metallic, or other particles mechanically suspended therein, preferably small particles of metallic foil, mica, or other more or less reflecting materials. The bulb may conveniently be blown on what may be called a compound tube, one half or other desired portion of which extending from end to end of the tube is of clear glass, and the remaining half, or other proportion, extending from end to end, of "metallic-glass." Or the bulb may be blown from two tubes, one of clear glass and one of "metallic glass," stuck end to end in a well-known manner. The compound tube may be made by squirting over a mandrel, or otherwise, the two kinds of glass issuing from separate receptacles, and meeting just before reaching the orifice from which they are squirted.

1797. "Improvements in electric bell furniture." F. KING and W. P. MENDHAM. Dated January 21. 6d. Complaints are frequently made as to the liability to accident by breakage of the stranded cord by which the pear pressell or push button is suspended from the rosette placed against the wall, and into which the line wires in an electric bell circuit are led. Persons unaccustomed to the use of electric bells often violently pull the cord in a downward direction, instead of merely pressing the ivory button in the suspended push or pressell, to make the necessary contact, the result being the cord is often broken under the strain and communication thereby destroyed. The object of the invention is to provide such means that whether the cord be pulled or the ivory button in the suspended pressell or push be pressed, the bell will be caused to ring. This the inventors accomplish preferably in the following manner: The stranded cord leading into the rosette is passed through a tube, preferably of some insulating material, and a block of ebonite or some other insulating material is placed at one end of the tube, a spiral spring being fitted round the tube between the block at one end and a washer at the other end, which washer may be fixed to the rosette. The object of the spring is to provide against the cord being broken by a sudden jerk, and is so arranged that it forms part of the circuit for the current, one end being connected to the line wire, the other end being connected to one strand of the hanging cord. The second strand is connected to a stud on the block, which stud, as the cord is pulled, rubs against a spring, against which it is always in contact, and to which the other line wire is attached. An additional stud in electrical connection with the first mentioned stud is fixed at the other end of the block, so that when the block is caused to move it may rub against another spring which is also connected to the line wire.

2073. "Improvements in or connected with primary and secondary batteries." A. TRIBE. Dated January 24. 2d. Relates to the employment and use for the purpose of the containers, receptacles, frames or supports, for the active elements of batteries of what is known as nitro cellulose, or that material substance or product which results from the treatment of ligneous or other material containing cellulose with acids, namely, with nitric acid, or with nitric acid in conjunction with sulphuric acid in a manner similar to that now employed in the production of what is known as gun cotton.

2234. "New or improved excitants for galvanic batteries." J. J. LUNDY, and W. F. BOTTOMLEY. Dated January 26. 2d. The chlorides hitherto employed as excitants for galvanic batteries have been those of ammonium, potassium, silver, sodium and zinc, the effect of which has been either to destroy or otherwise prejudiciously affect the electrodes or other parts of the battery, such as the terminals and connecting wires. The inventors have discovered that such detrimental effects may be obviated by substituting for such beforementioned chlorides, chlorides of magnesium or chloride of manganese; either of which alone, owing to their deliquescent properties, may be employed as excitants with extremely beneficial results. Another feature of the invention consists in using either chloride of magnesium or chloride of manganese, or both, in combination with each other, or with chloride of zinc in solution, or in combination with any other compatible chloride or chlorides; or in solution with any compatible salt or salts, such as sulphate of sodium, sulphate of magnesium, or sulphate of potassium.

2676. "An improved apparatus for conveying the light evolved from an incandescent electric lamp into parts or cavities of the human or animal body for surgical, dental, or other purposes." P. WARD. Dated February 4. 4d. The object of this invention is to construct a cheap and easily-manipulated means of lighting or illuminating parts or cavities of the human or animal body which it is impossible to examine properly, or to minutely inspect, unless the light is thrown upon or is in close proximity to the part under examination.

2696. "An improved lightning arrester for electric lines." A. M. CLARK. (Communicated from abroad by C. W. McDaniel, of America.) Dated February 4. 6d. The object of this invention is to prevent the coils of telephone instruments from being burnt and destroyed by strokes of lightning. In this apparatus three or more U shaped spring clamps on an insulating base are combined with an insulating strip, on which as many U shaped metal plates are secured as there are clamps on the base, which strip is adapted to be passed into the clamps. These metal plates have their adjoining edges serrated or toothed and separated a short distance, as in the usual lightning arresters. The end clamps are connected under the base by wires with binding posts, to which the line wires are connected, and the middle clamp is connected under the base by a wire with another binding post, with which the ground wire is connected. The middle plate on the insulating strip is provided with a handle piece of metal, around which a layer of fine silk-covered wire is coiled, the ends of which wire are connected by screws and bars with the end plates on the strip. The binding posts for the line wires are connected by wires with plates, between which can be passed a cut-out plug, which when not in use is contained in an aperture in the base. When the strip is removed a plate having hooks on the ends is passed between the end clamps. When several arresters are united on one base the several middle clamps of the base are united by a strip, on the end of which is secured a binding post, with which the ground wire is connected.

2855. "An improved method of and apparatus for conveying the light evolved from any source, natural or artificial, into parts or cavities of the human or animal body, for surgical, dental, and other purposes." P. WARD. Dated February 6. 4d. The object of this invention is to provide means whereby the part to be examined may be illuminated by a continuous homogeneous conductor of light, conveying and reflecting light from any source, either natural or artificial, in such a manner that the highest percentage of light is so utilised, obviating the hitherto inconvenient attendance of heat such as would emanate from an incandescent electric lamp introduced into the part.

3222. "Improvements in an electrical current measurer." H. F. JOEL. Dated February 13. 4d. The inventor constructs a galvanometer with a broad band of copper as the conductor, and a short magnetic needle of about the same length as the width of the copper band, he pivots the needle in a separate frame over the centre of the conductor, and mounts the whole upon a suitable base board. To the pivot of the needle is fixed a pointer with its under end overweighted by an adjustable screw bob. The magnet and pointer in their normal condition hang perpendicularly with their axis in a line with the centre of the conductor. To adjust and regulate this ampère meter, the needle is moved towards or away from the conductor, either by sliding it along the pivot, or alternatively by moving the needle and frame in which it is pivoted, backwards or forwards by means of a screw. The inventor also adjusts or calibrates the deflection of the needle by means of a small jockey counterweight, which is slid up or down upon the pointer itself. The magnetic needle is surrounded with a ring of soft iron, which, whilst not preventing the movement of the needle, acts as an armature, and also as a damper to the motion of the needle, at the same time it screens the needle from any outside disturbing magnetic influence.

3256. "Improvements in or applicable to switches or circuit closers for electrical conducting apparatus." J. H. HOLMES. Dated February 14. 6d. Relates to the apparatus described in the number of the REVIEW for January 3rd of this year.

3462. "Improvements in commutators of dynamo or magneto-electric machines and electro-motors." W. A. CARLYLE. Dated February 18. 6d. Has reference to such commutators of electrical machines as consist essentially of two metallic rings or sections of about the same diameter, having longitudinal bars formed therewith or attached thereto on that side of each which is next the other. Instead of making them of a complete annular form the inventor divides each ring or section longitudinally into two or more pieces, and connects them together by a nut screwed on each end concentrically with the armature shaft; or by bolts which fasten two divisions of the same ring or section together, the said bolts being insulated where necessary.

3551. "Improvements in electric telephones." A. A. CAMPBELL-SWINTON. Dated February 19. 6d. Two or more suspended

pendula, carrying pieces of some conducting material, are employed, and under the varying pressure of the sonorous vibrations of the atmospheric air are pressed with more or less force upon one or more other conducting bodies, and thus regulate the strength of an electric current flowing through the apparatus, so that the fluctuations in this current are in unison with, and in amplitude proportional to the afore'-mentioned sonorous vibration.

3669. "Method of giving fire alarms by electric current." J. STEPHEN. Dated February 21. 6d. Relates to an apparatus similar in principle to Brown and Saunders's individual telephone call.

3884. "An improved construction of carbon electrodes for electrolytical purposes." H. LIEPMANN. Dated February 25. 6d. The inventor forms the poles or electrodes of several carbons of comparatively small sectional area, and which can consequently be readily produced of uniform density and strength throughout, these small carbons being bound or secured together in such a manner as to form practically one piece, thus giving them the necessary size and strength, and at the same time providing a considerably increased surface. The groups of carbons are preferably arranged between discs of suitable material, so that the whole forms a kind of paddle wheel which is caused to rotate upon its axis, the different groups of carbons being connected together and also to the positive or to the negative pole of the source of electricity, so as to form either the anode or the cathode of the electrolytical apparatus.

3901. "Improvements in electric arc lamps." F. THORNTON and O. ROMANZE. Dated February 25. 6d. For controlling the descent of the upper carbon holder, the inventors employ a quick threaded screw, the rotation of which is controlled by an escape wheel fast upon it, the teeth of which engage with pallets on a vibrating pallet lever. The carbon holder descends by its own weight whenever the screw is allowed to turn, and the screw cannot turn without vibrating the pallet lever. When the upper carbon requires to be lowered the pallet lever is allowed to vibrate, and when it has been lowered to the extent required, the pallet lever is stopped from vibrating, and the descent of the upper carbon is thereby arrested. To arrest the vibration of the pallet lever whenever necessary, they employ a solenoid coil (through which the electric current is passed) to act upon a soft iron core, to which the stem of the quick threaded screw is coupled, so that when the carbons are brought together and the current passes freely, the soft iron core is drawn upwards, and so lifts the screw and with it the upper carbon holder, and separates the carbons. A serrated plate is by the same movement brought against a point carried by the vibrating pallet lever, and the vibrating movement of the pallet lever is thereby arrested. When the amount of current which is passing through the solenoid coil is insufficient to hold up the iron core the core descends, so again allowing the pallet lever to vibrate and the screw to turn so that the carbon holder again descends. The stem of the carbon holder is tubular, and can slide endwise in an outer tubular casing, this casing can also slide a short distance upwards or downwards, but cannot turn. The quick threaded screw passes downwards through the tubular stem of the carbon holder, and screws into a nut within it. The upper end of the stem of the screw can turn but cannot move endwise in a bearing formed at the top of the outer tubular casing. Above this bearing the stem of the screw carries the escapement wheel. The outer tubular casing has secured around it an iron tube, which forms the iron core of the solenoid. The outer casing has also a flange projecting from it; it rests on a coiled spring by which the greater part of the weight of the carbon holder and iron solenoid core can be sustained. By varying the strength of this spring, the lamp can be adjusted to work with varying strengths of electric current. A high resistance solenoid coil in shunt circuit is also made to surround the outer tubular casing of the carbon holder; it acts upon the lower end of the iron core in opposition to the main solenoid coil, and controls the action of the main coil upon the core. By raising or lowering this shunt coil, and so varying its position with reference to the soft iron core, the length of the arc may be regulated, or the lamp can be adjusted to work with any strength of electric current. When a fresh carbon is to be inserted into the upper carbon holder, the upper holder can be pressed upwards by hand, and as it cannot turn, it turns the quick threaded screw. The escapement wheel is not fast on the stem of the screw, but carries a spring pawl which engages with the teeth of a ratchet wheel that is fast on the stem of the screw, so that the screw can turn freely in the reverse direction to that in which it is turned when the carbon is to be lowered without turning the escapement wheel. Just before the upper carbon holder has descended to its lowest point, a projection from it may be made to come against the tail end of a contact lever, and by giving a slight movement to this lever, break the circuit and cut off the current from the lamp. By a further descent of the carbon holder the lever will be turned still further until a wedge piece, which is pressed by a spring towards V-teeth on the lever, is lifted by the action of one of the teeth pressing against it, and so soon as the point of the tooth passes the point of the wedge. the wedge will spring inwards and turn the switch arm quickly into position to complete the circuit of another lamp, and so bring that lamp into action in place of the one from which the current had been cut off.

4112. "Improvements in or connected with the commutators or collectors of electrical machines." J. H. JOHNSON. (Communicated from abroad by Z. T. Gramme, of Paris.) Dated February 28. 6d. Consists in a combination of devices for operating the commutator brushes or rubbers by causing the brush holders or carriers to oscillate simultaneously upon supports. In place of an oscillating motion the brush holders may be caused to partake of any other equivalent motion towards or from the commutator.

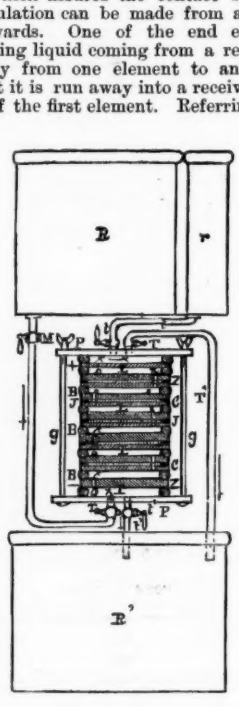
4158. "Improvements in and relating to thermo-electric piles or batteries." H. H. LAKE. (Communicated from abroad by D. Lautensack, A. Kohn, and O. Laske, all of Vienna.) Dated February 29. 6d. The alloys which generally serve as positive electrodes in thermo-electric batteries are very brittle and liable to fracture. The inventor therefore gives these electrodes a well insulated core of an elastic metal, which may either be the negative electrode or a neutral metal. Graphite is used by preference to form the insulating layer around the core, but clay, porcelain, glass, asbestos or the like do nearly the same service. If the said core is formed by the negative electrode, it runs through the whole length of the positive metal, and carries by one end a pole wire cast thereon, while the other end of both metals carries a piece of neutral plate destined to be heated. On the contrary, if the insulated core is formed by a neutral metal the said core may be wholly enclosed in the positive electrode and the negative electrode does the office of a heat-receiver. In both cases the heat-receiving metal piece either is sufficiently long to prevent the positive electrode, arranged to freely radiate warmth, from melting, or a strangulated portion is formed in this metal piece for the same purpose.

8918. "An apparatus for learning the art of telegraphy." C. KAHN. Dated June 13. 4d. Consists of a mechanical Morse key, which produces sounds similar to those in an ordinary sounder.

12127. "Improvements in incandescent electric lamps." W. P. THOMPSON. (Communicated from abroad by O. A. Moses, of America.) Dated September 8. 8d. The globe is constructed of a single piece of glass, which is preferably blown into a mould, whereby all the lamps are rendered uniform in size, and, contrary to the usual custom, they are formed entirely spherical and with a smooth surface at the lower end, that is to say, opposite to the neck, where it is usually customary to form a slight projection for the purpose of attaching a tube and exhausting the air after the conductors have been secured in place. This is rendered unnecessary for the reason that by this invention the globe is exhausted and closed at the end at or near which the conductors enter. The neck of the globe is afterwards narrowed or diminished in size, and it is cut or broken off, by a suitable tool, near the bulb or globe. The conducting filament is then inserted within the globe, and the conducting wires leading to the same are suspended across the edge of the neck of the globe. By means of a blow-pipe the glass is then heated about the conducting wires, which are preferably of platinum. The wires by reason of their own weight sink into the glass as it becomes softened, and the glass closes above them. If, however, this action should not take place quickly enough, a little particle of glass is fused upon the exposed platinum wire resting on the globe, for the purpose of holding the conductors and the filament firmly during the subsequent manipulations. The portion of the neck which was at first cut off is then placed against the neck from which it was removed, and the two are welded together by means of a blow-pipe, the two parts occupying the same relative positions as those they originally held. A platinum or other suitable metallic stopper is then inserted within the neck formed of the two sections which have been thus welded together into a whole tube, and the tube is then preferably drawn to a diameter that will prevent the stopper from falling out, or it may be curved to an angle for the same purpose. The air is then exhausted from the globe, and the glass is softened around the stopper at the lowest possible temperature, and caused to be compressed against the same. While the surrounding atmosphere is compressing the softened glass around the pin or stopper, the glass neck is elongated to still further ensure the close fitting of the pin to the neck of the tube which joins the lamp to the air-pump. In the sides of the neck there are preferably formed slight depressions which afford points for the holder to grasp the lamp and retain it in its proper position. The neck of the globe or chamber is, however, preferably otherwise straight. The form of carbon which it is preferable to employ in this globe consists of a carbonised filament formed in the shape of two incomplete circles, having preferably slightly different diameters, and united with each other by a curved continuation of the filament. The circles of different diameters serve a special purpose in preventing a continued movement of the filament when the lamp is jarred by breaking up the variations into ones of smaller amplitude. The form of the filament is also of especial advantage for producing and radiating as equal an amount of light as possible from a given length of conductor, and that too within as small an area of containing globe as possible. The supporting conducting wires for the filament are united thereto by means of a peculiar form of clamp which is formed at the end of each wire. This clamp is made by forming an enlargement at one end and then causing the enlargement to be flattened into a disc. The discs are doubled preferably in the axis of the wire, so that two lips are formed which are intended to receive the filament between them. The lips are then together bent out laterally, so that they project from the wire at right angles. One of these conducting wires is applied to each extremity of the filament, and they are preferably so arranged that the lips of the clamps are turned in toward each othor, so as to make use of the resilience of the carbon loop in case of a defective clamping.

12374. "Improvements in galvanic batteries." C. BAUDET. Dated September 13. 6d. The battery is composed of any con-

venient number of superposed elements, each of which consists of a plate of zinc, z, and a plate, c, serving as positive electrode, made of charcoal, platinum, platinised or non-platinised metal, or else of amalgamated copper or lead. This electrode can also be formed of any plate of metal covered with a coating composed of varnish and of graphite or plumbago, or of powdered carbon. The plates are separated by an India rubber frame, B, which forms a tight joint, and which is of sufficient thickness, so that each element forms a kind of chamber containing the exciting liquid. In order that the liquid may be renewed constantly, each plate is pierced by one or several holes opposite or not to each other in the superposition of the electrodes. A joint, J, separates the elements in order that the liquid may pass from one element to another without waste. For the joining the joint can be made of any kind of resin holding in suspension metal filings or powdered charcoal which assures the contact between the two elements. The circulation can be made from above downwards or from below upwards. One of the end elements, therefore, receives the exciting liquid coming from a receiver. This liquid passes successively from one element to another, and when it arrives at the last it is run away into a receiver placed at a level lower than that of the first element. Referring to the figure, the



following are the various parts :—R, receiver containing the exciting liquid; r, reservoir of water to wash the battery; R¹, lower receiver receiving the liquids having passed through the battery; T, pipe leading the exciting liquid to the lower part of the battery; T¹, outlet pipe leading the used liquid from the upper part of the battery into the bottom receiver, R¹; t, pipe leading the water of the reservoir, r, to the upper part of the battery to wash the latter after use; t¹, pipe leading the wash water into the bottom receiver, R¹; M, moderating tap regulating the speed of circulation of the exciting liquid. When the battery is at work, the taps of the pipe, T, and T¹, are open, and those of the pipes, t, and t¹, are closed. To stop the working, the taps, T, and T¹, of the exciting liquid are closed, and the taps, t, and t¹, are opened to allow the water to pass into the battery. Z, zinc or negative electrode; C, positive electrode; B, frame of India rubber, paper, or other material; J, joint separating a negative electrode from the positive electrode of the following pair; L, chamber containing the circulating fluid; O, orifices for the circulation of the liquid from one element to another; P, plates to connect by means of rods and screw nuts, q, all the elements of the battery, and carrying the sockets for the pipes, T, T¹, t, t¹.

CORRESPONDENCE.

Electric Cables.

In reference to your leading article in the current number of the REVIEW it may be of interest to you and the readers of the Journal to know that I and a gentleman, whose name I am not at liberty to mention, hope to be able to very shortly perfect a method of insulating and laying underground wires which will not be subject to the defects inherent in either resinous or brittle insulators, or to leakage or waste, and which will be at once simple to lay down or alter, and which in view of the necessities of telephone and electric light services will enable the individual conductor to be got at without interruption of the remainder.

I will send you full details of the whole as soon as the tests are complete.

Gerald Percival.

30, Old George's Street, Cork.
January 12th, 1885.

An Undulatory Current in a Closed Circuit, not necessary for Telephonic Transmission of Articulate Speech.

My attention has been called to two papers on this subject signed "Das Telephon," published in your excellent REVIEW of February 2nd and 9th, 1884, in which are given extracts from affidavits of several eminent American physicists, namely, Profs. Morton, Mayer, Cross, Wright, Wagner, and others, all of whom testified that articulate speech has been transmitted and reproduced in rapidly interrupted electric circuits. I invite those interested to read the papers referred to. Copies of the affidavits have been kindly sent to me since my communication on this subject in the REVIEW of 3rd inst. The theory of Profs. Cross and Wright is fully proven by the experiments made by me as detailed in my communication above referred to. I shall be pleased to lend to anyone those affidavits, and I invite the editors of *La Lumière Electrique* to reconsider their statement published in November, 1882, that "As to the question of knowing whether currents completely interrupted can reproduce speech, there is no electrician who can answer it."

I invite them to repeat the experiment described by me, and then abandon their pet theory about the undulatory currents being absolutely necessary for the transmission of articulate speech. That a closed circuit is not necessary for such a purpose my numerous experiments have conclusively proved, and I will add that undulations of the current corresponding to the undulations of the air waves produced by the voice seem to me to exist more in theory than in practice.

In all transmitters heretofore known the sound waves fall upon what may be termed a current regulator, either directly or through the medium of a tympan or diaphragm, whereby greater or less pressure is made upon the loose joints of the current regulator, producing a motion corresponding in its movement to the vibrations of the air waves, which is an up and down motion—a vibratory motion—and the increase or diminution of the current is caused by the greater or less pressure of the parts of the current regulator against one another, being the principle of the action of transmitter claimed by Edison. Now I have for several months past been experimenting with a novel form of Hughes's beautiful invention—the carbon microphone. This microphone is made of hard carbon pencils, without top, bottom, or sides, but simply held together by a frame not more than an eighth of an inch wide; loose pencils lie loosely upon loose pencils, which latter lie loosely on blocks of carbon. The articulation is excellent in whatever direction the air waves impinge on the pencils, but the tone is very much louder when the air waves impinge on the sides of the pencils and cause them to shake or jolt, and change their points of contact. Such movement is no doubt caused by the vibrations of the air waves, but can a jolting motion be said to be a vibratory motion, or to correspond to a vibratory motion.

It is conceivable that regular vibrations of air waves impinging upon a tympan or diaphragm will cause regular vibrations of the diaphragm or tympan, and those regular vibrations may cause corresponding variations of an electric current; but it certainly is yet to be explained how a jolting or shaking motion producing variations of points of contact of a microphone should produce variations in a current to cause the receiving instrument in the circuit to repeat the articulate words which have produced the shaking or jolting motion.

W. C. Barney.

January 19th, 1885.

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TIMES of *August 18th*.—"The lamps as finally adopted were the Woodhouse & Rawson Glow Lamps of 50 candle-power each, and these were variously arranged for the purpose of comparison as to the best method of suspension and light distribution. Some of them were placed singly and also in small clusters on poles 20 feet high, while others were suspended singly from cantilevers over the pathways and at a less height. Others, again, were suspended at a height of 20 feet above the centre of the roadway, and 100 feet apart. A current of 2 ampères was supplied to each Lamp, which takes 52 volts and 2 ampères, which equals 104 watts, and gives an efficiency of 2 *watts per candle*. This, it will be seen, is a very high efficiency, that of the Swan Lamp being stated to be 3½ watts, and that of the Edison Lamp 4 watts per candle. It is noteworthy, too, that no breakage of the Lamps adopted occurred during the trials."

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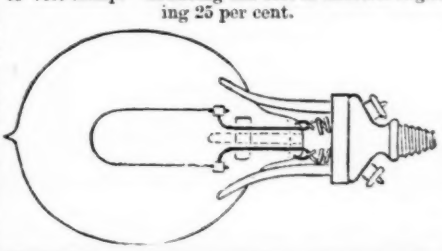

WORKS—CADBY HALL WORKS, HAMMERSMITH.

DAILY NEWS of *April 11th* on the Wimbledon Comparative Tests.—"The night before last some experiments were made with the Woodhouse & Rawson Lamps, which were regarded as very successful, and indicated an amount of efficiency that was astonishing. This enterprising firm have recently made great strides in the improvement of Incandescent Lamps."

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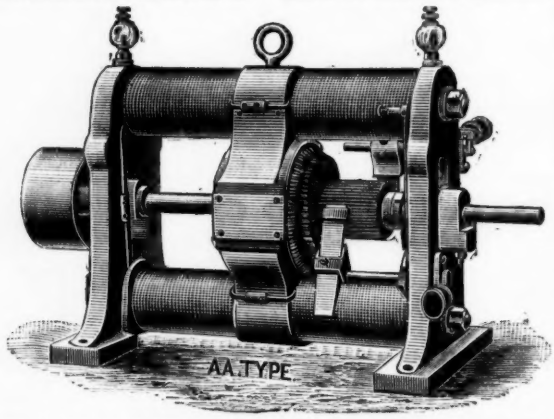

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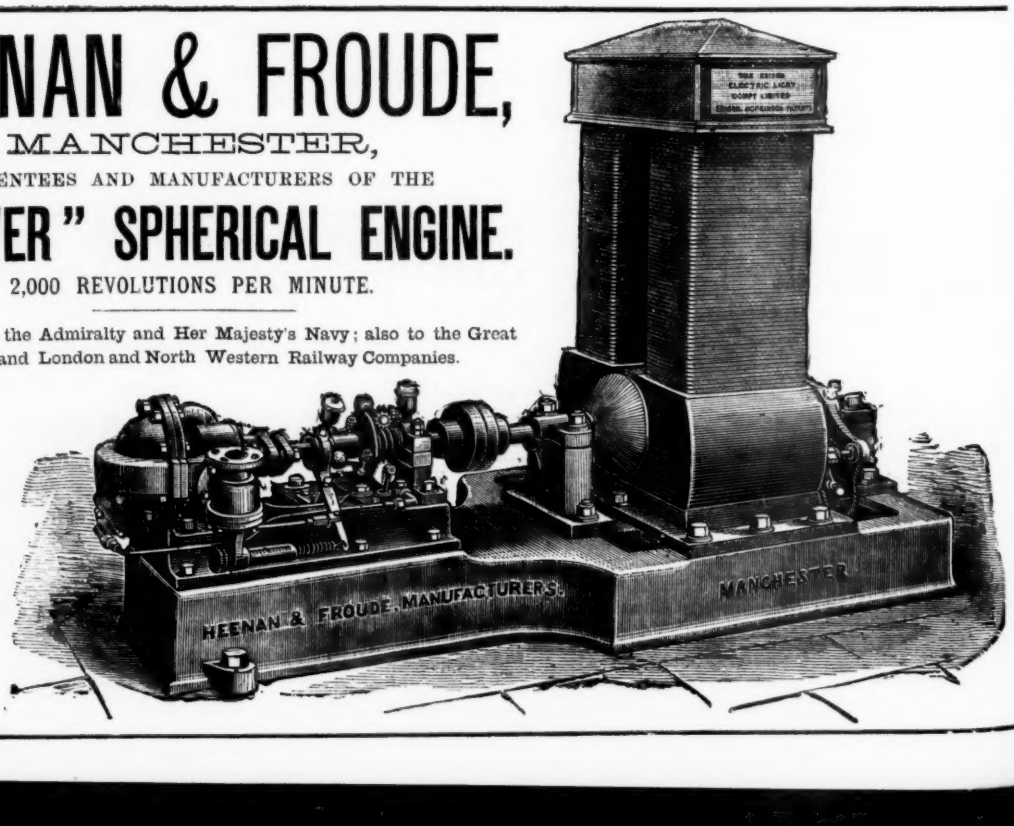
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